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Intermittent Gravity: How Much, How Often, How Long?

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Joan Vernikos, Ames Research Center, Moffett Field, California
David A. Ludwig, University of North Carolina, Greensboro, North Carolina

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Ames Research Center
Moffett Field, California 94035-1000

Table of Contents

Preface

This technical memorandum is a compilation of the results of a 4-day head-down bed rest (HDBR) study. This study was designed to investigate the effects of 4 days of HDBR alone or with 2 or 4 hours of standing or walking intermittently during each day of HDBR on orthostatic tolerance, maintenance of working capacity (peak oxygen uptake), calcium excretion, and endocrine and fluid and electrolyte responses. The following investigators participated: A. C. Ertl, Ph.D., C. E. Wade, Ph.D., L. Keil, Ph.D., J. E. Greenleaf, Ph.D., and D. O'Hara, R.N., NASA Ames Research Center, Moffett Field, CA 94035-1000. In addition, M. R. Duvoisin, Ph.D., and J. L. Stinn, Ph.D., Biomedical Operations and Research Office, NASA Kennedy Space Center, FL 32899, were instrumental in developing the software for the monitoring and recording of continuous cardiovascular data during the orthostatic tests and St. J. Maloney and V. Reyna for data analyses and compilation of this document. Portions of this report were funded by NASA Ames Research Center Consortium Agreement #NCA2-629.

Joan Vernikos, Ph.D.
Chief (Acting)
Life Science Division
NASA Ames Research Center
Moffett Field, California

David A. Ludwig, Ph.D.
Associate Professor of
Mathematics and Statistics
University of North Carolina
Greensboro, North Carolina

Glossary

ANCOVA	analysis of covariance
ANOVA	analysis of variance
ANP	atrial natriuretic peptide
APA	alkaline picric acid
AVP	arginine vasopressin
BP	blood pressure
bpm	beats per minute
BR	bed rest
BV	blood volume
C	ambulatory control
Ca	calcium
DBP	diastolic blood pressure
E	epinephrine
F	fainter during tilt test
G	gravity
G_z	gravity in head-to-toe vector
GFR	glomerular filtration rate
Hct	hematocrit
HDBR	head-down bed rest
HDL	high density lipoprotein
HR	heart rate
HRF	Human Research Facility
ISE	ion specific electrode
K	potassium
LBNP	lower body negative pressure
LDL	low density lipoprotein
MAP	mean arterial pressure
Na	sodium
NE	norepinephrine
NF	non-fainter during tilt test
P	probability value
PRA	plasma renin activity
PV	plasma volume
RIA	radioimmunoassay
S	standing condition (e.g., S4, standing for 4 hours)
SBP	systolic blood pressure
SD	standard deviation
SE	standard error
$\dot{V}O_{2peak}$	peak oxygen consumption
W	walking condition (e.g., W4, walking for 4 hours)

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JOAN VERNIKOS AND DAVID A. LUDWIG*

Ames Research Center

Summary

Continuous exposure to gravity may not be necessary to prevent the deconditioning effects of microgravity. It is not known, however, what the minimum gravity (G) exposure requirements are, whether they vary for different physiological systems, or whether passive G_z (gravity in the head-to-toe vector) or activity in a G field is more effective in preventing deconditioning. It is also not known what the optimal characteristics of the G stimulus should be in terms of amplitude, duration, and frequency. To begin to address these questions, we conducted a 4-day –6° head-down bed rest (HDBR) study. Nine males (aged 30–50 yr) were subjected, over a period of seven months, to four different +1 G_z exposure protocols (periodic standing or controlled walking each for a total of 2 or 4 hr/day in individual 15-min doses), plus a control (0 G_z) of continuous HDBR.

The study consisted of one ambulatory control day, 4 full days of –6° HDBR, and a recovery day when subjects were released at the end of HDBR after completion of tests. A battery of tests was selected and standardized in order to evaluate the known early responses to HDBR. Dependent variables of interest included orthostatic tolerance (30 min at 60° head-up tilt) and hemodynamics during head-up tilt, peak oxygen consumption ($\dot{V}O_{2peak}$) plasma volume (PV), and urinary calcium (Ca).

The results were as follows: (1) 4 hr standing completely prevented and 2 hr walking partially prevented post-HDBR orthostatic intolerance. Walking at 3 mi/hr for 4 hr/day provided no additional benefit. (2) Intermittent walking attenuated, but did not prevent, the decrease in $\dot{V}O_{2peak}$. (3) Both 4 hr conditions showed less PV loss by the end of HDBR; both 2 hr conditions were without effect. (4) Both 2 and 4 hr walking essentially prevented urinary Ca excretion and were more effective than standing. It is concluded that different physiological systems benefit differentially from passive +1 G_z or activity in +1 G_z, and the intensity of the stimulus may be an important contributing factor.

Introduction

All terrestrial living systems, including humans, have evolved over millions of years in the continuous presence of Earth's gravitational force, gradually developing, adapting, and migrating from sea to land. It is therefore not too surprising that animals and humans physiologically decondition very rapidly in microgravity, suggesting that chronic exposure to gravity (G) is important in maintaining a gravity-adapted state. Whether this chronic exposure must be continuous or can take the form of periodic "vaccinations" has been the subject of a few studies conducted mostly in the sixties and of much debate and speculation over the ensuing years. In the meantime, the search in the last 30 years for effective countermeasures to the effects of spaceflight has met with limited success. Concern is growing, especially as longer duration missions are being planned, that either comprehensive countermeasures will not be developed in time or that effective countermeasure procedures will be so time consuming and cumbersome that it would be unrealistic to expect crews to devote 2–4 hr/day, as some Russian crews have done (Garshnek et al., 1989), in order to maintain adequate health, fitness, and productivity.

Although Soviet cosmonauts have been in space for as long as a year and have performed an extensive and intensive exercise and lower body negative pressure (LBNP) countermeasure program, they cannot walk unassisted for at least 48 hr after landing. They have also not been required to maintain or restore skilled physical performance in order to land their spacecraft as U.S. astronauts must, be immediately able to egress in an emergency, or perform adequately and consistently on landing in another gravitational field such as Mars. It appears, then, that exposure to some effective G level is probably essential to restore vascular hydrostatic pressures, enhance the effectiveness of exercise and activity on muscular strength and endurance, aerobic work capacity, and bone integrity and strength, and provide afferent input to maintain integrity of neural regulatory functions.

*University of North Carolina.

Head-down bed rest (HDBR) and horizontal bed rest, to a lesser extent, as ground simulation analogues of microgravity, have been used extensively to induce most of the physiological effects also observed during deconditioning in microgravity. This indicates that at least three aspects of a G condition are involved in maintaining normal health and fitness: the pull of the G force in the G_z (head-to-toe) direction, exertion against the G force, and the element of "change" provided by postural and other movement/orientation cues only possible in a gravitational field.

Normal, ambulatory people spend approximately 8 hr/day sleeping (horizontally) and 16 hr/day in the upright sitting or ambulatory mode. Whether all of the 16 hr/day at +1 G_z are needed to maintain overall normal health and fitness is not known. The results of classic, though not definitive, studies (because of the small number of subjects used) have come from bed rest (BR) research studies conducted at the Lankenau Hospital in Philadelphia in the 1960s. These studies show that:

(a) Eight hours daily of quiet sitting plus 16 hr/day of horizontal BR resulted in only minor decreases in aerobic capacity (maximal oxygen uptake); tilt tolerance was maintained in 3 of 4 subjects (Birkhead et al., 1964a).

(b) Cycle leg exercise for 2–4 hr/day in the supine position for 18 days was ineffective in reducing tilt intolerance or hypercalciuria. Quiet standing for 3 hr/day with 21 hr/day of horizontal BR decreased tilt intolerance in 3 of 5 subjects and decreased urinary calcium (Ca) excretion in 4 of 5 subjects. Application of intermittent LBNP in one subject attenuated development of tilt intolerance but increased urinary Ca excretion (Birkhead et al., 1966).

(c) One hour daily of supine or sitting leg exercise at 600 kpm/min for 24–42 days maintained aerobic capacity, but did not prevent tilt intolerance or increased urinary Ca loss in subjects (Birkhead et al., 1963; 1964b).

Rodahl et al. (1967) summarized the findings from these Lankenau experiments:

(a) Supine leg cycle exercise training for 2–4 hr/day during BR

1. may maintain muscular strength and aerobic capacity.

2. has no effect on urinary Ca loss.

3. has no effect on tilt intolerance.

(b) Quiet sitting for 8 hr/day during BR

1. has minimal effect on maintenance of muscular strength and aerobic capacity.

2. has no effect on urinary Ca loss.

3. reduces tilt intolerance.

(c) Quiet standing for 3 hr/day during BR

1. (muscular strength or aerobic capacity was not measured).

2. reduces increased urinary Ca excretion to ambulatory levels.

3. reduces tilt intolerance.

More recent evidence indicates that exposure to three 20-min sessions of LBNP (at –35 mmHg) daily virtually eliminates orthostatic (tilt) intolerance after 30 days of –6° HDBR (Guell, 1990). Kakurin et al. (1978) reported that an exercise protocol, performed for 58–67 min/day, consisting of leg cycling, rowing, inertial-impact loading on the legs, and breathing exercises, maintained the muscular strength and aerobic capacity of six men during 49 days of –4° HDBR. In addition, we have found that, after 30 days of –6° HDBR, high intensity and short duration aerobic exercise (leg cycle ergometry at 40% max) for 1 hr/day maintains aerobic capacity, and high intensity, intermittent, short duration isokinetic leg exercise maintains strength and endurance (Greenleaf et al., 1989; 1994). Whereas it appears possible to maintain aerobic capacity, muscle strength, and endurance with a variety of supine exercise procedures, some form of orthostatic stimulus seems to be necessary to prevent orthostatic intolerance. The magnitude and duration of such a stimulus, however, are unknown.

The most effective time of day to expose subjects to a +1 G_z stimulus is also important. During the night hours many physiological systems are unresponsive. Diuresis, natriuresis, and calciuresis, for example, do not occur in response to immersion or BR (Shiraki et al., 1986). This blunting of responses is independent of sleep or posture and appears to be a function of the circadian trough. How pervasive this nocturnal blunting to gravitational and other stimuli is across physiological systems has not received much attention. Nevertheless, it would appear that there is an optimal time in the diurnal cycle when the effectiveness of G_z stimuli are at their greatest. This optimal time does not appear to be during the circadian nadir or the nocturnal part of the cycle. It could therefore be inferred that exposure to a G_z force by centrifugation during sleep, as has been proposed by some (Cardus et al., 1990), would be of no substantial benefit.

Whether it is passive exposure to +1 G_z or the activity we carry out normally in +1 G_z that is the optimum stimulus in health maintenance is another question. It has been proposed (Whalen et al., 1988; Whalen, 1993) that, for maintenance of bone strength, it is the activity we conduct in a G field that is most effective. Whalen (1993) has

proposed that the apparent bone loss in spaceflight is secondary to the reduction in gravitational forces on the skeleton. This implies that exercise regimens that are selected as countermeasures must, in concert with the G force, replace absent mechanical stimuli and stresses.

Periodic hypergravity exposures during BR have been used in a few studies (Murray et al., 1965; White, 1965; Nyberg et al., 1966; Piemme et al., 1966; Dowell et al., 1968; Kotovskaya et al., 1977; Grigor'yev and Shulzhenko, 1979; Shulzhenko et al., 1979; Shulzhenko and Vil-Viliams, 1992). These studies have focused primarily on preventing post-bedrest or post-dry immersion orthostatic intolerance by exposing subjects 2–3 times a day for short periods of time to gravity levels up to +2 G_z. Some of these studies have suggested that such intermittent hypergravity exposures also induce fluid and sodium (Na) retention and prevent changes in plasma volume (PV). The fundamental flaw in these studies is that they have not been comprehensive, and tests and measurements vary, so that comparisons across regimens and across physiological systems are near impossible.

Exposure of animals to continuous gravity inflight provided by an onboard short radius centrifuge on the Cosmos-782 and Cosmos-936 Biosatellites indicated that this exposure protected animals from the physiological responses to spaceflight. In ground studies, using a 2 m radius centrifuge, Shulzhenko and Vil-Viliams (1992) exposed human subjects to periods of 40–60 min time blocks of continuous gravity during 3-day or 28-day dry immersions; exposure was 2–3 times a day to 1.3, 1.6, and 1.9 G either alone or with exercise or salt loading. The beneficial effects of these exposures were very encouraging. More studies are needed, but must be approached in a systematic fashion so that specific requirements for the most effective periodic centrifugation protocol may be developed.

Many questions remain unanswered regarding maintenance of health and fitness in spaceflight: What is the minimum exposure per 24 hr of +1 G_z? Does exposure have to be presented in a block of time or in divided doses? Is it the total duration of exposure per 24 hr or the number of bouts that is the crucial variable? What is the most effective time of day to expose subjects? Is it passive exposure to +1 G_z or the activity we carry out normally in +1 G_z that is the optimum stimulus in health maintenance? Does increasing the intensity of the +G_z stimulus reduce the time of exposure needed (i.e., does hypergravity increase the efficacy of +G_z exposure)? Do all physiological systems respond to gravitational treatment in a similar way? What are the side effects of short arm centrifugation? Can you stress the body by providing "weightbearing" by other means such as LBNP (Hargens et al., 1991; 1992)?

In order to address systematically the many questions that must be answered so that artificial G requirements for prolonged missions may be determined, it was important to develop the simplest ground simulation model possible whose cost would not be prohibitive and that: 1) would give reliable, measurable, and consistent changes within the briefest period of time; 2) could be repeated frequently, preferably in the same individuals; and, 3) would be based on an experimental design that could be randomized to enable relatively easy screening of various permutations of G stimulus presentation. It was also important to select the most sensitive tests available and standardize them in order to assess the extent of the deconditioning effects.

The value of –6° HDBR as a ground simulation analog of the effects of microgravity has been well documented (Grigor'yev et al., 1986; Convertino, 1994). Although we and others (Dallman et al., 1984; Baisch et al., 1992; Vernikos et al., 1993) have conducted numerous HDBR studies of 7 days or longer, the artificial gravity working group that met at NASA Ames Research Center (Artificial Gravity Workshop, NASA Ames Research Center, Galileo Room, April 11–13, 1989) indicated that 3 or 4 days of HDBR could serve as a reliable model for the rapid screening of preventive or therapeutic treatments, in large part because of the sufficiently large, consistent, and reproducible physiological responses induced during this time. Orthostatic intolerance becomes apparent within a few hours of –6° HDBR (Loellgen et al., 1984; Butler et al., 1991), and, although PV is somewhat reduced by 24 hr, reduction is essentially maximal by 3 days (Dallman et al., 1984; Heer et al., 1992). Diuresis and natriuresis occur mostly within the first 48 hr (Heer et al., 1992; Vernikos et al., 1993). Maximal oxygen consumption changes have also been reported evident within 48 hr of HDBR (Nixon et al., 1979). We therefore selected 4 days of HDBR as an appropriate time frame to acquire significant early adaptive responses and screen various dose, time, and frequency permutations of the +G_z stimulus. A 4-day HDBR study also had the advantage of being both practical and cost effective as it required, including control periods before and after HDBR, only a week to complete.

Methods

Subjects

Nine healthy, nonsmoking, normotensive men (paid volunteers), with a mean (SD) age of 37.9 (4.5) yr, a mean

height of 181.7 (5.1) cm, and a mean weight of 84.4 (7.8) kg, gave written consent to participate in this study. Participation was contingent on a positive medical screening that consisted of a detailed medical history and a physical examination. Subjects were recruited from the San Francisco Bay Area and were of average fitness for their age [mean peak oxygen consumption ($\dot{V}O_{2peak}$) = 32.1 ml/kg/min]. Prior to testing and subject recruitment, the study protocol was approved by the NASA Ames Human Research Experiments Review Board. Subjects were thoroughly briefed on all aspects of the experimental protocol before consenting to participate. One of the nine subjects withdrew from the study and did not participate in the 2 hr walking and standing conditions. Table 1 shows the subjects' control test data and body weights over the seven months of testing.

Treatments and Experimental Protocol

Each of the nine subjects was tested across five treatment conditions to evaluate the effects of periodic +1 G_z gravity during 4 days of continuous –6° HDBR (each subject received each treatment during five 4-day HDBR exposures). The order in which the subjects received the treatments was counterbalanced as much as possible but was restricted due to the size and availability of the Human Research Facility (HRF) at NASA Ames Research Center. The treatments, as summarized in table 2, included: 1) no intervention (0 G_z condition); 2) 4 hr of intermittent standing per day; 3) 4 hr of intermittent walking per day; 4) 2 hr of intermittent standing per day; 5) 2 hr of intermittent walking per day. The 4-hr treatments were conducted in 15-min bouts each hour for 16 hr. The 2-hr treatments were also conducted in 15-min bouts but over an 8 hr period. Standing was done quietly without support while walking was at 3 mph on a level treadmill. Minimum recovery time between treatments was one month. In addition, each subject was tested both pre- and post-HDBR across all conditions. Thus the experimental layout can be viewed as a self matched (paired) experiment with multiple controls (five pre-HDBR control measurements).

Experimental Conditions

Admission of subjects was staggered so that three subjects were admitted daily to the HRF and released six days later. Subjects were supervised 24 hr/day while in the HRF to assure that they adhered to the bed rest regimen. Transportation to and from $\dot{V}O_{2peak}$ and tilt test rooms was in horizontal or –6° head-down position as appropriate; showering was done in horizontal position and excretory functions in –6° head-down position. During –6° HDBR, subjects were allowed one pillow. To facilitate eating, a subject was allowed to raise his head and rest it in his hand as long as the upper part of his arm was resting flat against the mattress. Smoking, caffeine containing drinks, and medications (including vitamins) were not allowed during the study. Lights were on from 0700 hr to 2300 hr for all subjects except those standing at 2315 hr and walking at 2330 hr.

All subjects were maintained throughout the study on a standard diet of 2500-2800 Kcal/day including 190 mEq Na (±20) and 90 mEq potassium (K) (±10). Subjects were required to drink a minimum of one liter/day of fluids which included fluids from their food trays; there was no upper limit on the amount of fluids allowed. Subjects were required to keep accurate food and fluid intake

Table 1. Control data from tests on the same subjects during their five visits before each HDBR exposure. N = number of subjects per group. Data are shown as mean ± standard error. Tilt tolerance is the percentage of subjects completing a 30-min 60° head-up tilt test

	N = 9	N = 8	N = 9	N = 8	N = 9
Body weight (kg)	82.72 ± 2.58	84.21 ± 3.44	83.49 ± 2.71	84.88 ± 3.30	83.50 ± 2.50
Tilt tolerance	75% (6 of 8)	100% (8 of 8)	100% (9 of 9)	75% (6 of 8)	77.8% (7 of 9)
Peak $\dot{V}O_2$ (L/min)	2.66 ± 0.15	2.64 ± 0.15	2.70 ± 0.13	2.66 ± 0.18	2.70 ± 0.15
PV (ml)	2685.8 ± 169.2	2438.4 ± 103.4	2607.4 ± 150.8	2390.7 ± 114.4	2987.6 ± 289.2
Urinary Ca (mg/24 hr)	135.4 ± 22.8	201.0 ± 23.5	177.6 ± 28.2	212.5 ± 17.7	199.3 ± 21.3

Table 2. Five treatment conditions

1. Four days of HDBR (no intervention), zero G simulation condition (OG).
2. Four days of HDBR with 4 hours of intermittent standing per day (1GS4).
3. Four days of HDBR with 4 hours of intermittent walking per day (1GW4).
4. Four days of HDBR with 2 hours of intermittent standing per (1GS2).
5. Four days of HDBR with 2 hours of intermittent walking per day (1GW2).

records during the study including records of the amount of sodium consumed.

Experimental Procedures

In the two week period preceding each HDBR exposure, subjects came on an outsubject basis to establish peak oxygen consumption. Upon admission to the facility for each HDBR exposure, an admission physical was done which included measurement of height, weight, and vital signs (oral temperature, heart rate, respiration, and blood pressure). Vital signs were taken each day during the HDBR exposure at 0700 and 1900 hr; weight and vital signs were again determined following the $\dot{V}O_{2peak}$ test on the recovery day prior to release.

On the day after admission, there was one ambulatory control day when early-morning fasting PV and tilt tolerance were determined. On the following day, after awakening, getting up, having a standardized light breakfast and generally being ambulatory for 2 hr, subjects began the HDBR period. Treatments started 1 hr after beginning HDBR. Plasma volume and tilt tolerance were again determined on day 4 of HDBR. At the end of this tilt test, subjects, without ever ambulating, were placed back in the –6° head-down position and returned to their beds. Subjects following walking or standing treatments resumed treatment the hour following the tilt test, thus missing only the treatment replaced by the 30-min tilt test. Subjects remained in the –6° head-down position until the next day (the recovery day) when a $\dot{V}O_{2peak}$ test was again performed using a supine bicycle ergometer. Following completion of this last test, subjects were allowed to ambulate and were then released.

Blood Samples

Blood samples (supine) were taken on the ambulatory control day and on HDBR day 4 for PV determination and for analysis of electrolytes and fluid regulating hormones. In addition, a blood sample was taken 4 hr after beginning HDBR and also analyzed for various fluid regulating hormone changes as compared to a supine control blood sample taken after lying quietly supine for 45 min on the ambulatory control day.

Blood samples were collected using the Becton Dickinson Vacutainer system, as appropriate, into test tubes containing heparin, EDTA, or no anticoagulant. The use of anticoagulants had no effect on subsequent analyses. The tubes were kept in crushed ice and then centrifuged at 4° C for 20 min at 2500 rpm. Plasma or serum were removed, allocated into individual tubes for each assay, and immediately frozen for later analysis.

Urine Samples

Volumes and times of void-by-void specimens were recorded daily. Urine pools (24-hr) were collected throughout each study for the determination of fluid and electrolyte balance. Aliquots from each pool were frozen and stored for later analysis.

Tilt Tolerance Test

Orthostatic tolerance testing was performed pre-bed rest on the ambulatory control day, after subjects had been lying quietly in the supine position (horizontal) for 45 min prior to the test. Testing was performed again on HDBR day 4. Testing both times was performed on a NASA developed tilt table. On the ambulatory control day, subjects were transported by gurney to the tilt room in horizontal position; on HDBR day 4, transportation was by gurney with subjects in –6° head-down tilt position. In the tilt room, subjects slid over onto the tilt table (horizontal on ambulatory control day; –6° head-down on HDBR day 4) and positioned themselves in the center of the table with their feet just touching the table foot rest. A folded towel was placed under the heels for better positioning of the feet during tilt. A wide band, secured on both sides of the table, was placed loosely across the waist to make the subject feel more secure. After a 5-min pre-tilt control period, subjects were tilted within 10–15 sec to 60° head-up for 30 min or until signs and symptoms of pre-syncope (e.g., nausea, dizziness, sweating, lightheadedness, and tunnel vision) occurred. Subjects were then immediately returned to a horizontal (ambulatory control day) or –6° head-down (HDBR day 4) position for a recovery period of at least 10 min. An Ohmeda 2300 (Ohmeda, BOC Group Inc., Englewood, Colo.) Finapres™ blood pressure (BP) monitor was used to monitor BP and heart rate (HR) continuously during the test (5-min pre-tilt control period, tilt, post-tilt recovery period). An arm rest, attached to the tilt table, was used to keep the subject's hand at heart level at all times to ensure the collection of consistent and reliable data. Pre- and post-tilt manual blood pressure readings were also taken and recorded. Upon completion of the test, subjects were transported back to their beds by gurney (in horizontal position on ambulatory control day; in –6° head-down tilt position on HDRB day 4). A medical monitor was in attendance at all times during the tests.

The Finapres fingercuff BP monitoring device used to provide beat-by-beat measurement of peripheral BP measures BP using a small finger cuff that contains a photoplethysmographic volume transducer and an inflatable air bladder. The cuff is connected to a fast-response servo control system that instantaneously regulates the pressure applied to the finger through the bladder and, thus, the pressure applied to the walls of the arteries. As BP

increases, the arterial wall expands, increasing the volume of the finger. This volume differential is measured by the plethysmographic transducer. The Finapres monitor responds to the increasing volume by increasing cuff pressure until the original arterial size and blood volume (BV) are again reached. The external pressure continuously adjusted by the cuff closely follows the intra-arterial pressure within the finger, allowing measurement of the external pressure itself as a function of the arterial BP.

Peak Oxygen Consumption Test

Prior to and following 4 days of –6° HDBR, $\dot{V}O_{2peak}$ was determined using indirect calorimetry during supine leg cycling ergometry. During an initial visit, subjects were familiarized with the exercise testing equipment and completed an incremental submaximal test. In the two week period preceding the first HDBR exposure, a $\dot{V}O_{2peak}$ test was administered. Several days later, and before beginning HDBR, subjects completed a second $\dot{V}O_{2peak}$ test to verify results of the first test. In the two week period preceding the four subsequent HDBR exposures, all subjects came again on an outsubject basis to establish peak oxygen consumption. Post-HDBR $\dot{V}O_{2peak}$ tests were administered on the recovery day of all HDBR exposures. For the post-HDBR tests on the recovery day, subjects were transported by gurney between the HRF and the test room (before and after completion of the tests) in –6° head-down tilt position. Subjects were horizontal during the administration of all $\dot{V}O_{2peak}$ tests.

The term $\dot{V}O_{2peak}$ is used rather than maximal oxygen consumption ($\dot{V}O_{2max}$) since a plateau or decrease in oxygen consumption with an increase in load was not a criterion for measurement. $\dot{V}O_{2peak}$ is defined as the highest minute oxygen consumption measured during incremental loads on the ergometer.

The protocol for $\dot{V}O_{2peak}$ consisted of a 5-min warmup at 400 kg-m·min^{-1} which was followed by three 2-min incremental loads of 200 kg-m·min^{-1} estimated to elicit $\dot{V}O_{2peak}$. If the subject was able to complete the third incremental load, an additional increase of 200 kg-m·min^{-1} was given. The subjects exercised to volitional fatigue, or the test was terminated if the subject was unable to maintain a pedaling frequency above 50 rpm. After completion of the test, resistance was reduced so that the subject could recover comfortably. Hand grips and shoulder braces were used for stabilization during the test.

The three loads used to reach the peak load were estimated from the results of the submaximal test. In the first $\dot{V}O_{2peak}$ test, the three peak loads were set to achieve exhaustion with the third load (within 5–6 min). If the subjects were not able to exercise for a least 1 min at the peak load, or required a fourth load to reach exhaustion, the peak loads were adjusted.

Reported results are submaximal HR response to the initial 5-min warmup prior to the peak protocol (400 kg-m·min^{-1}), the average $\dot{V}O_2$ of the highest four 15-sec values obtained during the peak power output, and the maximal HR achieved during the test.

Exercise testing was performed on a Quinton model 846T Imaging/Ergometer Table (Quinton Instruments, Seattle, Wash.). The metabolic gas collection system utilized an on-line data acquisition system. Subjects breathed through a low-resistance, high flow Rudolph valve. Inspired gas volumes were measured using a Pneumoscan S-301 spirometer (Vacumed, Ventura, Calif.). Oxygen and carbon dioxide concentrations were measured on Ametek Applied Electrochemistry (Pittsburg, PA) S-3A1 and CD-3A analyzers respectively. Analog data was converted to digital by Vista model 17002 system and software (Vacumed, Ventura, Calif.) and fed to an IBM PC AT for calculation. Heart rate data was collected on a Hewlett Packard cardiotachometer model 78905A and ECG module model 78203C (Hewlett Packard, Medical Products Group, Waltham, Mass.).

Plasma Volume

Plasma volume was measured using a modified Evans blue dye dilution method (Greenleaf et al., 1979; Greenleaf and Hinghofer-Szalkay, 1985). The procedure was performed on each subject on the ambulatory control day and again on HDBR day 4 after subjects were awakened at 0700 hr and before they were served breakfast. A Becton Dickinson Vacutainer Blood Collection Set with a 21-gauge needle, attached to a 3-way stopcock, was used to obtain blood samples. A pre-injection blood sample was drawn. The pre-weighed Evans blue dye solution (2.5 ml/subject) in the syringe was injected and a second blood sample was drawn 10 min later. The empty syringe used to inject the Evans blue was saved for weighing in order to calculate the amount of Evans blue dye actually used for each PV test. The IV line was kept patent with a slow drip of sterile 5% dextrose solution. No more than 50 ml of dextrose was used over the 10-min period.

The blood samples were centrifuged and plasma stored at –70° C. At the completion of the study, analysis was done on all samples by a modified column extraction procedure of Greenleaf and Hinghofer-Szalkay (1985) using Sephadex columns (Pharmacia LKB Biotechnology, Uppsala, Sweden) in place of Solka Floc columns.

Blood volume was calculated using the subject's PV and hematocrit (Hct) values with BV (in ml) = PV (in ml) × [100/[100 – (0.91 × Hct)]].

Blood Analyses

Hematocrit measurements were made using a micro-hematocrit centrifuge (CT-2900, Adams Micro-Hematocrit Centrifuge, Clay-Adams, Inc., N.Y.). Vasopressin and catecholamine measurements for a subject were done in a single assay for each hormone. Vasopressin (AVP) was measured by radioimmunoassay (RIA) using the method of Keil and Severs (1977); the within-assay coefficient of variability was 9% and assay sensitivity was 0.3 pg/ml. Plasma norepinephrine (NE) and epinephrine (E) were separated by high performance liquid chromatography (HPLC) and then measured by electrochemical detection (Bioanalytical Systems, West Lafayette, Ind.); within-assay variabilities were 5% (NE) and 3% (E) and sensitivities for both were 5 pg/ml (Wade et al., 1991). Plasma renin activity (PRA) was measured by RIA for angiotensin I (kit from New England Nuclear, Boston, Mass.) with a within-assay coefficient of variability of 7%, an inter-assay coefficient of variability of 8%, and sensitivity of 30 ng/ml/hr. Aldosterone and cortisol were measured using RIA kits from Diagnostic Products Corporation (Los Angeles, Calif.); within-assay coefficients of variability, inter-assay coefficients of variability, and sensitivities were 4%, 8%, and 2.5 ng/dl for aldosterone and 3%, 4.4%, and 1 µg/100 ml for cortisol, respectively. Atrial natriuretic peptide (ANP) was measured by Waters column extraction (Waters Chromatography Division, Millipore Corporation, Milford, Mass.) followed by RIA (kit from Peninsula Laboratories, Inc., Belmont, Calif.), with a within-assay coefficient of variability of 5%, an inter-assay coefficient of variability of 15%, and sensitivity of 1.5 pg/tube. Plasma Na and K were measured by ion specific electrode (ISE) (Cobas Mira, Roche Diagnostic Systems, Nutley, N.J.). Plasma osmolality was measured using an Advanced Digimatic Osmometer (Model 3D11, Advanced Instruments, Inc., Needham Heights, Mass.). Serum total protein was measured by hand refractometer (National, No. 15064, Japan) and serum creatinine by an alkaline picric acid (APA) method (Cobas Mira, Roche Diagnostic Systems, Nutley, N.J.). Total cholesterol, high density lipoprotein (HDL) cholesterol, and triglyceride concentrations were measured by an enzymatic chemistry procedure (Cobas Mira, Roche Diagnostic Systems, Nutley, N.J.) and low density lipoprotein (LDL) cholesterol was calculated using the formula LDL cholesterol = Total cholesterol – [HDL cholesterol + (Triglycerides/5)].

Urine Analyses

Urinary creatinine was measured by APA (Cobas Mira, Roche Diagnostic Systems, Nutley, N.J.) and the glomerular filtration rate (GFR) calculated using the formula GFR = (Urinary creatinine excretion rate/Serum creatinine)/1440. Urinary osmolality was measured using an Advanced Digimatic Osmometer (Model 3D11, Advanced Instruments, Inc., Needham Heights, Mass.). Urinary cortisol was measured using a RIA kit from Diagnostic Products Corporation (Los Angeles, Calif.); the within-assay coefficient of variability was 3%, the inter-assay coefficient of variability was 4.4%, and sensitivity was 1 µg/100 ml. Urinary Ca concentration was measured by Arsenazo III colored complex (Cobas Mira, Roche Diagnostic Systems, Nutley, N.J.) and urinary Na and K were measured by ISE (Cobas Mira, Roche Diagnostic Systems, Nutley, N.J.) .

Statistics

The general experimental design consisted of nine subjects who received five experimental treatments (including no intervention). Each subject received each of the five treatments (in random or near random order) and were measured before and after each treatment. Some of the dependent variables were measured over time (daily) during HDBR. The general statistical model is therefore a five treatment randomized block (subjects are the blocking factor) with two or five repeated measures. When only two repeated measures were taken (pre- and post-treatment), the repeated measures were differenced and the differences were analyzed. This is equivalent to the test of interaction in a standard repeated measures ANOVA. The test of the difference scores evaluates differences in the rate of change for the given dependent variable across treatments after subject-to-subject variation has been removed (subjects are crossed with treatments). When more than two repeated measures were taken, the rate of change was quantified by the slope of the response across the repeated measures. The slopes were either first order (linear) or second order (quadratic) depending on the shape of the response function. These slopes were then analyzed using the same model as the difference scores. To correct for differences due to starting points, slopes and differences were adjusted for pre-HDBR values by analysis of covariance (pre-HDBR values were used as a covariate). The statistical tests for both slopes and differences evaluate the differences in rate of change across the five treatments after correcting for initial values. A more detailed description of this approach is given by Laird (1983).

Line or bar charts were used for graphical analysis. Mean variation is presented on the graphs as error bars (standard

errors). Estimates of variation and mean values are based on the raw data (data specific to that mean) when no statistical test was performed. When a statistical test was performed, pooled estimates of variation and adjusted means from the analysis of covariance are presented. Unadjusted means for all variables are given in the appendix. Specific comparisons (least significant differences) between treatment means were calculated from the pooled error obtained from the ANCOVA. In the event of missing observations (due to subject withdrawal or equipment failure), statistical estimates were adjusted by least squares. Since the general linear model was the basis for all the statistical analyses, adjustment due to missing data was inherent to the statistical methodology.

Exact statistical probabilities (Type I error rates) are given along with the size of the test statistic and the degrees of freedom. The statistical probabilities can be interpreted as the chances of observing a difference as large or larger than the one observed if in fact the treatments had no effect. Thus, a low probability (P value) would indicate an unusual situation under the hypothesis of no treatment differences. It might then be concluded that the observed experimental difference is a result of factors other than random experimental variation. In order to help control the experimentwise Type I error rate, statistical tests were only applied to dependent variables of primary interest (orthostatic tolerance, $\dot{V}O_{2peak}$, PV, urinary Ca).

Raw data for all dependent variables are in the appendix.

Statistics: orthostatic tolerance– The statistical methods applied to HR and BP data from the tilt test are different from those described above due to the large amounts of data (beat to beat) collected during the testing. Similarly, analysis of fainting rates (proportion fainting during the tilt test) required more specialized statistical procedures appropriate for the analysis of proportions.

One discrete and four continuous measures were used as dependent variables in quantifying orthostatic intolerance. The discrete variable was the proportion of the nine subjects who successfully completed a tilt test without experiencing syncope or pre-syncopal symptoms ("survival rate"). The four continuous variables were HR, mean arterial pressure (MAP), and the two components of MAP, systolic (SBP) and diastolic (DBP) pressures. The statistical analysis used the final 3 min prior to the 60° head-up tilt as the control period. The tilt test lasted for 30 min. Heart rate and BP (Finapres at heart level at all times) were measured continuously before and during the tilt test and digitally recorded every 3 sec on magnetic tape. This equates to approximately 700 data points per subject per variable. Fifteen sec averages were taken to reduce the data to 140 data points per subject per variable. This time series of 140 points occurring during the pre-tilt control and the tilt test was used in the statistical analysis. Ten "survival rates" (proportion completing a tilt test without experiencing syncope or pre-syncopal symptoms) were calculated from the five pre-HDBR (control) and the five post-HDBR (treatment) tilt tests.

Statistical comparison of the pre-HDBR control measures to the post-HDBR treatment conditions was accomplished with the use of control charts (i.e., Shewhart charts) and multiple regression techniques (time series analysis). A control chart was constructed for each of the five dependent variables from the five pre-HDBR measurements. This was possible since multiple control measures were taken on the same subject prior to each HDBR exposure and subsequent treatment. From this replicated pre-HDBR information, variation in the physiological system when it is functioning normally could be estimated. This inherent variation (which also includes experimental variation and measurement error) is graphically depicted in the form of approximate 95% control limits on the control chart. Experimental inference can then be made by comparing the response under stress or during different treatments to these limits. This statistical approach is similar to methods described by Box et al. (1978) in that data internal to the experiment is used as the reference distribution rather than reference distributions based on normal theory (i.e., z, t, F, etc.). A more detailed account of these statistical procedures is given by Montgomery (1985).

Control charts for survival rate were constructed in the same manner as those for HR and MAP. For comparative purposes, a survival rate analysis based on asymptotic normal theory was performed. The overall survival rate from the five multiple control periods was tested against each of the five treatment conditions using the Mantel-Haenszel procedure for matched case control studies with multiple controls per case (Kleinbaum et al., 1982).

Results

Orthostatic Tolerance: Heart Rate And Blood Pressure

The control charts for HR, MAP, SBP, and DBP are presented in figures 1–4 respectively. Panel A of all four figures presents the average time series from the five pre-HDBR measurements, the overall linear model, and the approximate 95% control limits during the 30-min tilt test (plus 3 min of supine pre-tilt). Panel B in each figure compares the no intervention treatment (0 G_z) to the control limits while panels C and D compare the 2 and 4 hr treatments to the control limits for both standing and walking.

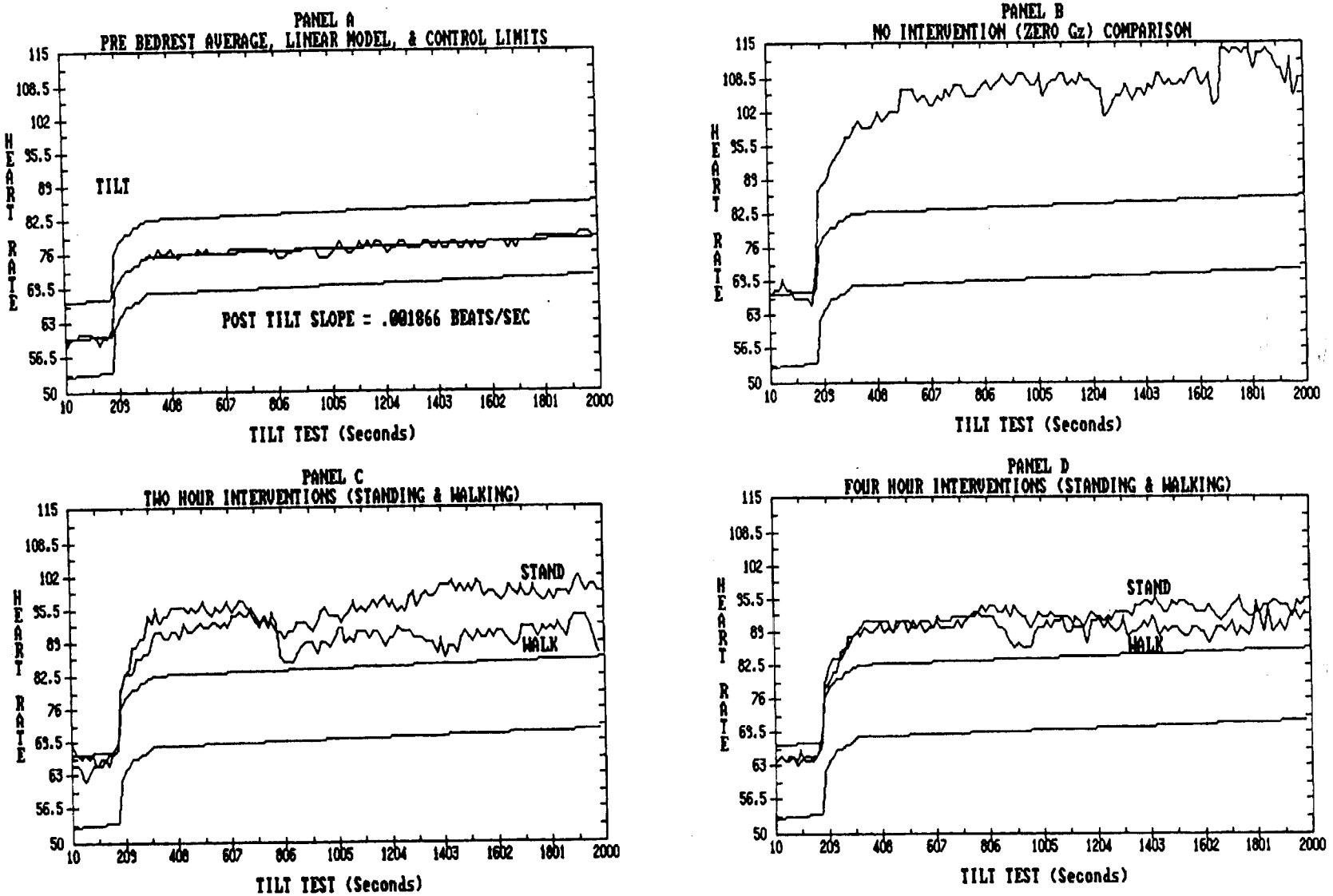


Figure 1. Heart rate response to 60° head-up tilt by treatment conditions [Panel A, average-time series from the five pre-HDBR measurements, the overall linear model, and the approximate 95% control limits during the 30-min tilt test (plus 3 min of supine pre-tilt); Panel B, no intervention (0 G_Z) compared to the control limits; Panel C, 2 hr treatments compared to the control limits for both standing and walking; Panel D, 4 hr treatments compared to the control limits for both standing and walking].

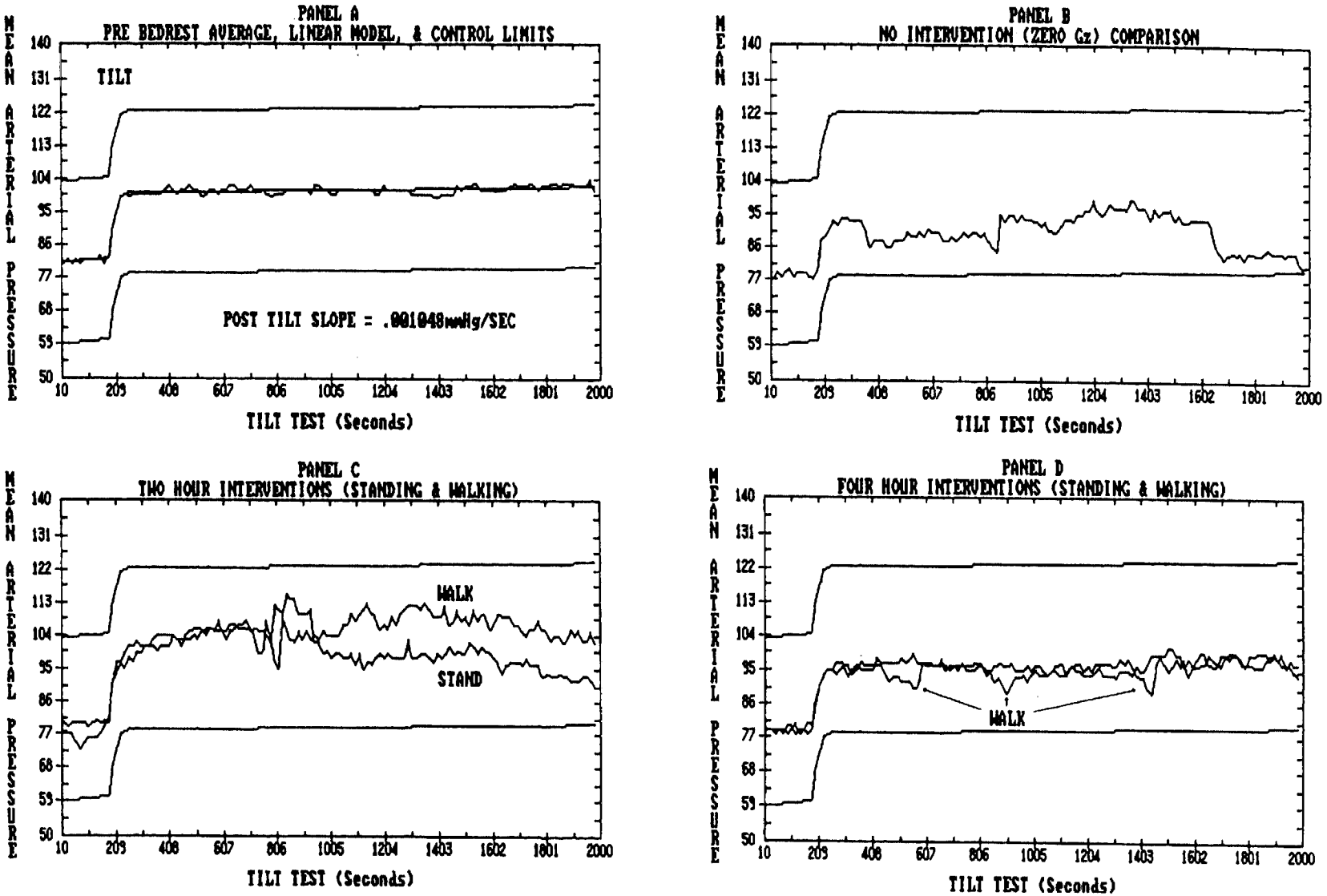


Figure 2. Mean arterial pressure response to 60° head-up tilt by treatment conditions [Panel A, average-time series from the five pre-HDBR measurements, the overall linear model, and the approximate 95% control limits during the 30-min tilt test (plus 3 min of supine pre-tilt); Panel B, no intervention (0 G_Z) compared to the control limits; Panel C, 2 hr treatments compared to the control limits for both standing and walking; Panel D, 4 hr treatments compared to the control limits for both standing and walking].

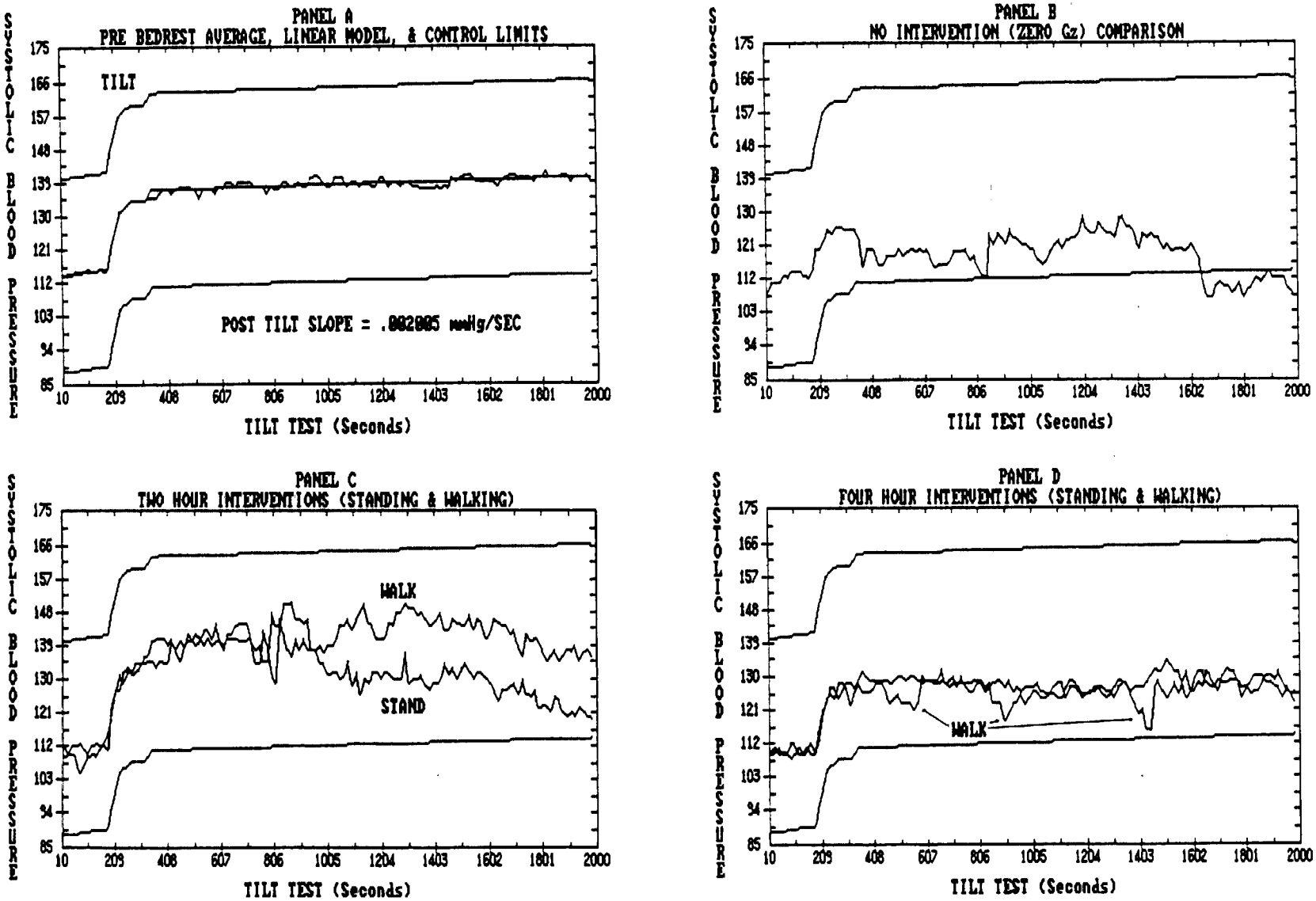


Figure 3. Systolic blood pressure response to 60° head-up tilt by treatment conditions [Panel A, average-time series from the five pre-HDBR measurements, the overall linear model, and the approximate 95% control limits during the 30-min tilt test (plus 3 min of supine pre-tilt); Panel B, no intervention (0 G_Z) compared to the control limits; Panel C, 2 hr treatments compared to the control limits for both standing and walking; Panel D, 4 hr treatments compared to the control limits for both standing and walking].

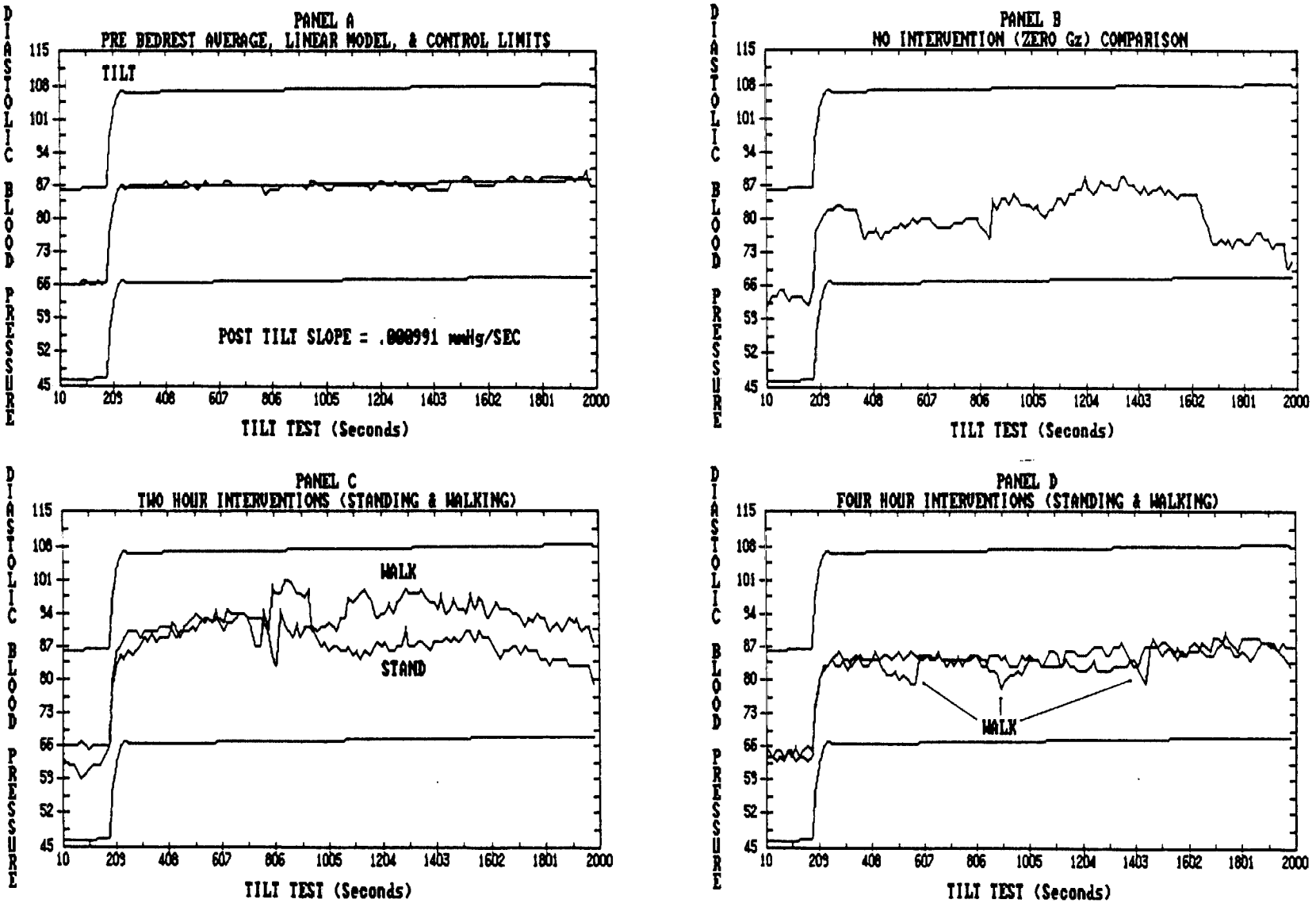


Figure 4. Diastolic blood pressure response to 60° head-up tilt by treatment conditions [Panel A, average-time series from the five pre-HDBR measurements, the overall linear model, and the approximate 95% control limits during the 30-min tilt test (plus 3 min of supine pre-tilt); Panel B, no intervention (0 G_z) compared to the control limits; Panel C, 2 hr treatments compared to the control limits for both standing and walking; Panel D, 4 hr treatments compared to the control limits for both standing and walking].

Heart rate responses– The average pre-HDBR (ambulatory control) HR response to tilt demonstrated an increase in HR from 60 beats per minute (bpm) during supine pre-tilt to 76 bpm at approximately 1 min post-tilt (+16 beats) (fig. 1, Panel A). Beats per minute continued to increase at a rate of 0.56 beats/5min during tilt, reaching an average maximum of 79 bpm by the end of the test. The 95% control limits were calculated at approximately ±7 beats around the least squares fit of the average time series (fig. 1, Panel A).

The no intervention comparison (control HDBR with no +1 G_z exposure) was well outside the control limits indicating a much different HR response to tilt after HDBR (fig. 1, Panel B). The pre-tilt HR was elevated by approximately 6 bpm (66 bpm) and rose to 102 bpm following tilt (+36 bpm). At 1390 sec into tilt, three of the nine subjects had failed the test. A slight survivor effect must be considered when evaluating the no intervention series past this point (i.e., only survivors are being evaluated during the latter part of the tilt test).

The 2 hr stand and walk series (fig. 1, Panel C) were also outside the control limits. As with the no intervention treatment, the supine HR was elevated by approximately 5 bpm rising to around 91 bpm following tilt (+26 beats). Heart rate for the 2 hr stand tended to increase during tilt in comparison to a somewhat constant HR for the 2 hr walk treatment.

The 4 hr stand and walk series were also outside the control limits during tilt but showed a slight improvement during pre-tilt (fig. 1, Panel D). Both series jumped to approximately 89 bpm following tilt (+25 beats) and remained outside the control limits for the remainder of the test. Heart rate for both 4 hr conditions remained relatively constant during tilt. Although the 4 hr stand series and 4 hr walk series were both outside the pre-HDBR control limits, they showed a marked improvement over the no intervention (0 G_z) treatment.

Although all the intervention treatments seemed to be an improvement over no intervention, none of the treatments completely restored HR response to pre-HDBR levels (all fell outside the control limits). All of the 2 and 4 hr walk and stand curves seemed comparable, except for a slightly elevated HR (both pre- and post-tilt) for the 2 hr conditions. Some possible interaction between exposure time and activity level can be seen in Panels C and D of figure 1. The HR for standing tends to be five to six beats higher than that for walking given the 2 hr condition, whereas little difference between standing and walking is seen in the 4 hr condition. Although not statistically discernible, perhaps activity is beneficial only when +G_z exposure is low (i.e., low in duration and/or intensity).

Mean arterial pressure responses– Average supine MAP during pre-HDBR was approximately 81 mmHg rising to 99 mmHg (+18 mmHg) post-tilt (fig. 2, Panel A). Mean arterial pressure continued to rise at a rate of approximately 0.52 mmHg/5min during tilt reaching an average maximum of approximately 103 mmHg by the end of the test. The 95% control limits were calculated at ±22 mmHg around the least squares fit of the average time series (fig. 2, Panel A).

For the 0 G_z treatment, MAP remained within the 95% control limits until the end of the tilt test (fig. 2, Panel B). The overall series tended to remain in the lower quarter of the control band through the majority of the test while dropping to near pre-tilt values by the end of the test. Supine pre-tilt values were slightly lower following HDBR (approximately 3 mm/Hg).

Although pressure for both 2 hr conditions tended to drop off at 1500 seconds, all of the intervention treatments maintained pressure within the 95% control limits (fig. 2, Panels C and D). As with HR, a slight interaction can be seen. While the 4 hr curves are basically indistinguishable and have slight positive slopes, the 2 hr curves begin to separate and decline at 800 sec. Changes in MAP for the 2 hr conditions confirm changes observed in HR. While the 2 hr standing condition produced higher HR than the 2 hr walk, the 2 hr walk produced greater pressure increases than the 2 hr stand. This reflects the attempt to compensate for lower pressure with higher HR.

Systolic blood pressure and diastolic blood pressure responses– Similar results can be seen for SBP (fig. 3) and DBP (fig. 4). Since MAP is a linear composite formed from SBP and DBP, the responses across the tilt test, by definition, would be similar.

Orthostatic Tolerance: Syncope Prevalence

The control chart and Mantel-Haenszel statistics for "survival rates" (proportion of subjects completing a tilt test without experiencing syncope or pre-syncopal symptoms) are presented in figure 5. Panel A of figure 5 gives the survival rates for the five pre-HDBR tests and the five post-HDBR treatments. Survival rates are based on nine subjects except for both 2 hr conditions, where one subject dropped out of the study, and the 0 G_z condition, where one subject became ill. Survival rates during pre-HDBR ranged from 1.00 to 0.75 with an average survival rate of 0.86. The lower bound of the approximate 95% control limit calculated from the range and standard deviation of the five pre-HDBR rates was 0.62, [0.86 – 1.96(0.12)]. The upper limit is bounded by 1.00. This indicates that under normal ambulatory conditions it would not be that unlikely that this sample of nine

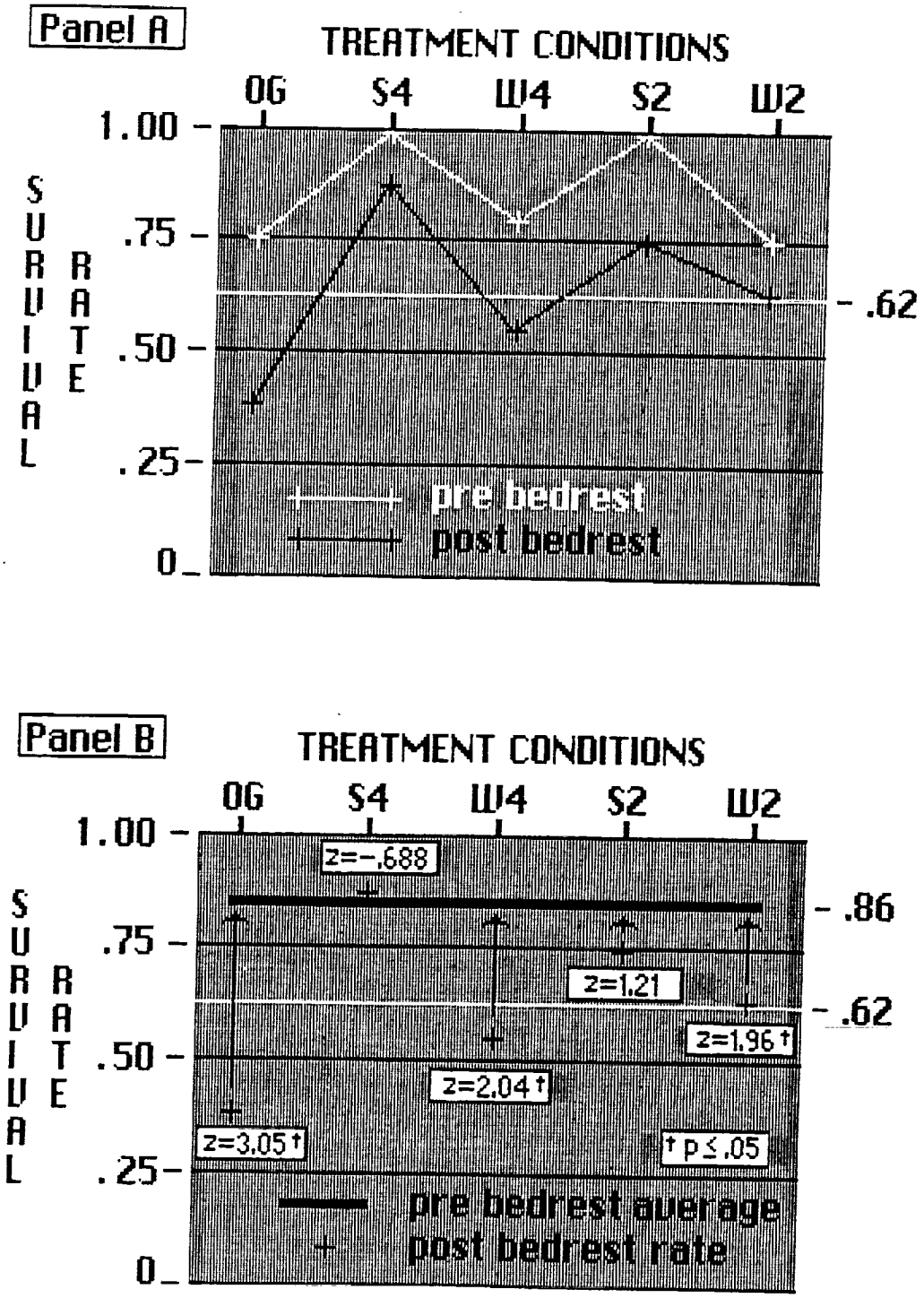


Figure 5. Tilt test survival rates (proportion completing the test) by treatment conditions for pre- and post-HDBR measurements (Panel A, survival rates and lower limit of the approximate 95% confidence interval; Panel B, Mantel-Haenszel comparison of post-HDBR rates to the pre-HDBR average). The traditional chi squared statistic was converted to z for ease of interpretation (critical value of z = 1.96 for a Type I error rate of 0.05). Value of z statistics and associated Type I probability levels are included in the figure. 0G, S4, W4, S2, and W2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions.

subjects would vary in their response to the tilt test (survival rate) by as much as ±24%. Therefore, until a treatment demonstrated a decrease in average survival rate of at least 24%, the difference would not be large enough to conclude an effect when compared to normal variation in survival rates when the subjects were ambulatory. Panel B presents the results of the Mantel-Haenszel comparisons of each post-HDBR survival rate to the average pre-HDBR rate. The traditional chi squared statistic was converted to z for ease of interpretation (critical value of z = 1.96 for a Type I error rate of 0.05).

The results from both analyses show a decrease in survival rates (orthostatic tolerance) from pre-HDBR conditions for the 0 G, 4 hr walk, and 2 hr walk, although the 2 hr walk condition was borderline. Both standing conditions seemed to maintain pre-HDBR levels with the 4 hr condition showing slightly better results. Walking did not improve the survival rate as both walking conditions were lower than both standing conditions. The results seem to indicate that passive G_z provides more protection than active G_z at least when compared to low level activity (walking). Perhaps the active conditions were less effective due to a lower orthostatic challenge resulting from augmented venous return during walking.

It was expected that HR and BP data would to some degree coincide with the survival rates. Only in the no intervention condition (0 G_z) did this seem to be true. Heart rate for the no intervention condition showed the highest elevation during tilt and was associated with the lowest survival rate. However, no relationship was seen between HR or BP and survival rates within the four intervention conditions.

Peak Oxygen Consumption

The results for the pre- to post-HDBR differences in $\dot{V}O_{2peak}$ are given in figure 6. The 95% confidence intervals around the treatment mean differences indicated that a non zero decline in $\dot{V}O_{2peak}$ occurred across all treatments (none of the confidence intervals included zero). All of the intervention treatments (Ps ≤ 0.0124) demonstrated significantly smaller decreases in $\dot{V}O_{2peak}$ than the 0 G_z condition. However, the 2 hr standing treatment, although lower, was not significantly different from the untreated condition (P = 0.1702). As expected, the walking conditions showed less of a decrease than the standing conditions. However, the 4 hr standing condition was an improvement over the 0 G_z condition. The results tended to favor the activity conditions with less of the effect due to exposure time.

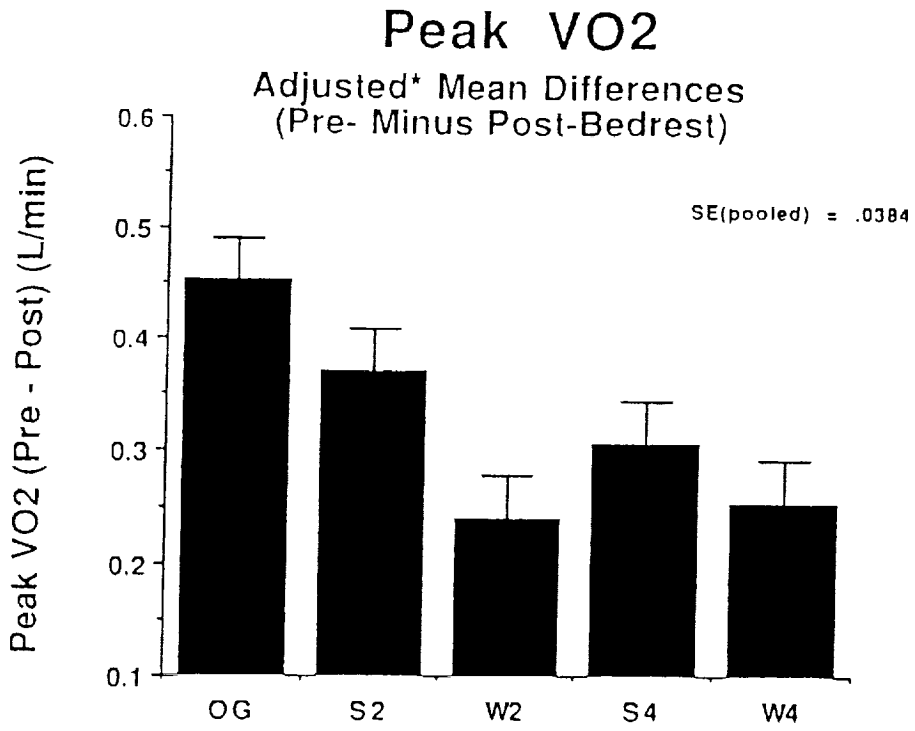
Plasma Volume

The results for the pre- to post-HDBR difference in PV are given in figure 7. Both 4 hr conditions showed less PV loss by the end of HDBR as compared to the untreated, 0 G_z condition (S4: P = 0.0623; W4: P = 0.0383). No difference in PV change from pre- to post-HDBR was detected between the 0 G_z and the 2 hr conditions (P ≥ 0.7375). The results indicate that treatment conditions with a longer exposure time (4 hr) were most effective, with little difference attributable to activity (walking versus standing). However, the 4 hr walking condition produced the least amount of pre- to post-HDBR change (see adjusted means and confidence intervals).

Urinary Calcium

Since urinary Ca was measured daily during HDBR, a more complete analysis over days based on statistical modeling was possible. Figure 8 (Upper Panels) presents the actual urinary Ca output and actual % change in urinary Ca by treatment condition and day. Figure 8 (Lower Panel) gives the predicted urinary Ca based on a quadratic polynomial model. Predicted urinary Ca was based on a linear statistical model containing a constant, a linear, and a quadratic term. The coefficients from the linear and quadratic components for each treatment condition were compared to access differences in response across HDBR. This was done by estimating the linear and quadratic terms for each subject and then testing the difference in these terms across treatment conditions. As described in the methods section, after the linear and quadratic coefficients were estimated for each subject, these coefficients were analyzed with analysis of covariance holding the initial Ca output (value at ambulatory control day) constant.

Figure 9 presents the analysis of the linear component. Although all of the treatment conditions showed a positive linear increase in Ca excretion over HDBR days, the rate of change was, for the most part, constant for all treatment groups. On the average, the linear rate of change per day was approximately 10 mg (see adjusted means and confidence levels). The analysis of the quadratic component is given in figure 10. This component represents the amount of change (bend in the trend) over time. The results indicate that the quadratic trend over time for the two standing conditions (both 2 and 4 hr) was not different from the trend for the 0 G condition (untreated). In contrast, the two walking conditions were much flatter with only slight positive quadratic trends (W2: P = 0.0109; W4: P = 0.0262). (See fig. 8, Predicted Calcium.)



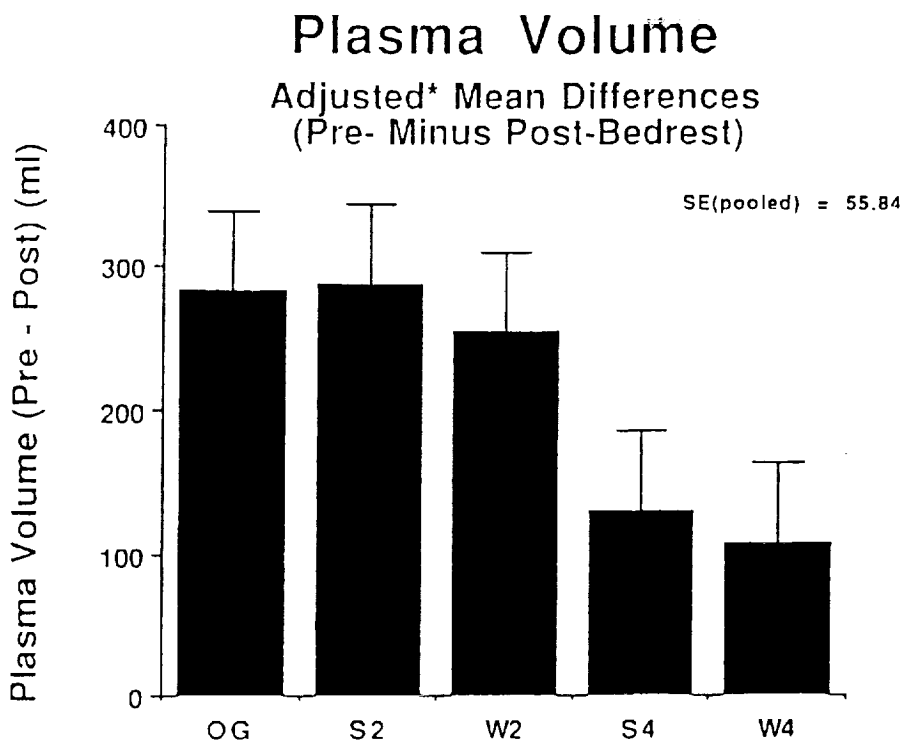
* Adjusted for Pre-Bedrest Values. Overall F test for treatment differences (ANCOVA) = 4.96; df = 4, 29; P = .0036.

Treatment	Adjusted Mean Difference Pre-Post Bedrest	Approximate 95% Confidence Interval	
		Lower Limit	Upper Limit
OG	.4510	.3741	.5279
S2	.3703	.2934	.4472
W2	.2405	.1636	.3174
S4	.3054	.2285	.3823
W4	.2539	.1770	.3308

Pairwise Comparisons (OG to Other Treatments)

OG versus:	Difference	t(29)	P
S2	.0807	1.41	.1702
W2	.2105	3.70	.0009
S4	.1456	2.67	.0124
W4	.1971	3.60	.0012

Figure 6. Pre- to post-HDBR differences in $\dot{V}O_{2peak}$. 0G, S2, W2, S4, and W4 denote respectively the no treatment and the 2 hr stand, 2 hr walk, 4 hr stand, and 4 hr walk treatment conditions. Values are adjusted mean differencs ± SE (pooled).



* Adjusted for Pre-Bedrest Values. Overall F test for treatment differences (ANCOVA) = 2.12; df = 4, 29; P = .1035.

Treatment	Adjusted Mean Difference Pre-Post Bedrest	Approximate 95% Confidence Interval	
		Lower Limit	Upper Limit
OG	282.98	171.30	394.66
S2	288.11	176.43	399.79
W2	254.47	142.79	366.15
S4	129.63	17.95	241.31
W4	107.58	-4.10	219.26

Pairwise Comparisons (OG to Other Treatments)

OG versus:	Difference	t(29)	P
S2	-5.14	-0.06	.7515
W2	28.51	0.34	.7375
S4	153.35	1.94	.0623
W4	175.40	2.17	.0383

Figure 7. Pre- to post-HDBR differences in plasma volume. 0G, S2, W2, S4, and W4 denote respectively the no treatment and the 2 hr stand, 2 hr walk, 4 hr stand, and 4 hr walk treatment conditions. Values are adjusted mean differences ± SE (pooled).

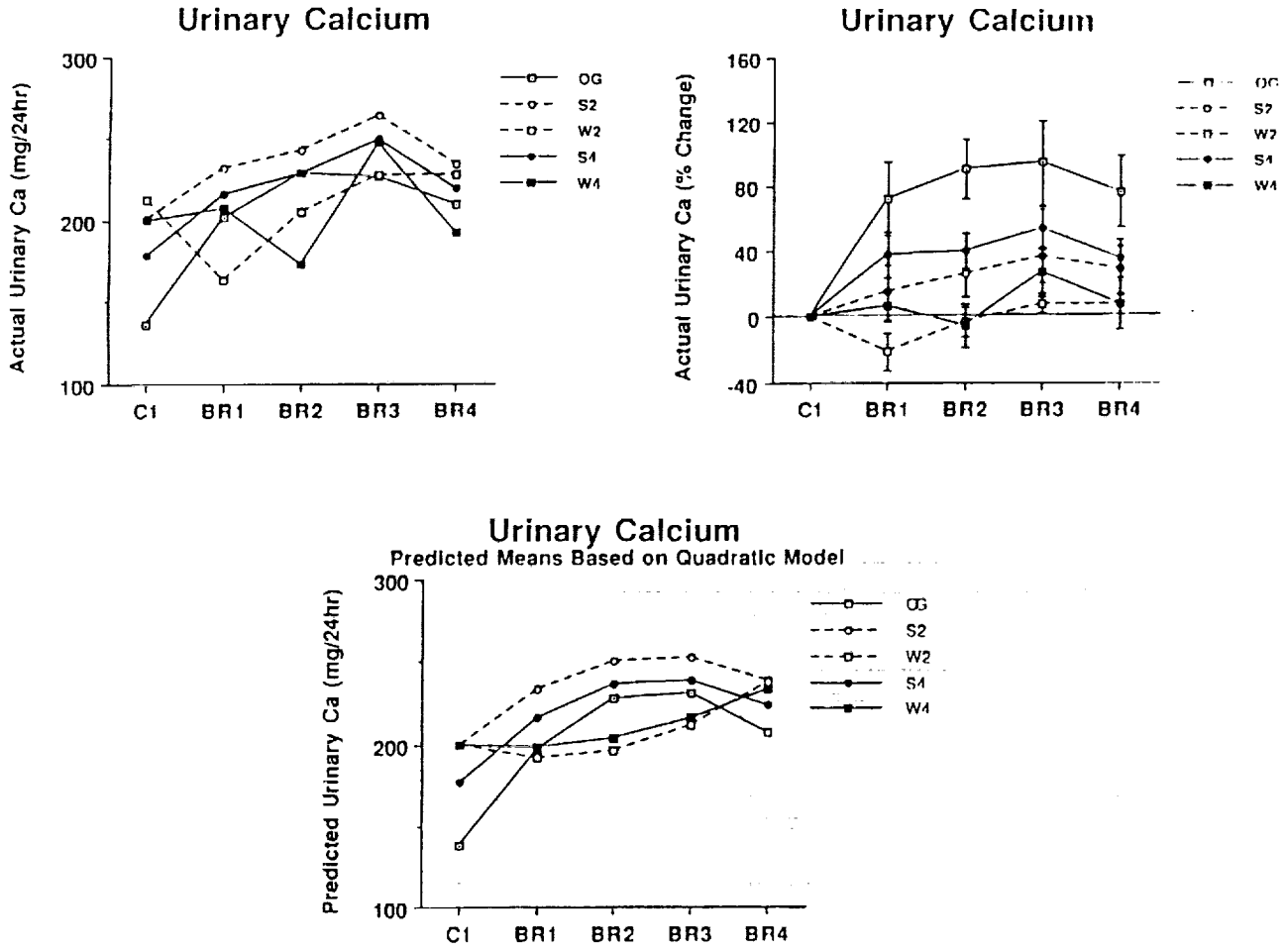
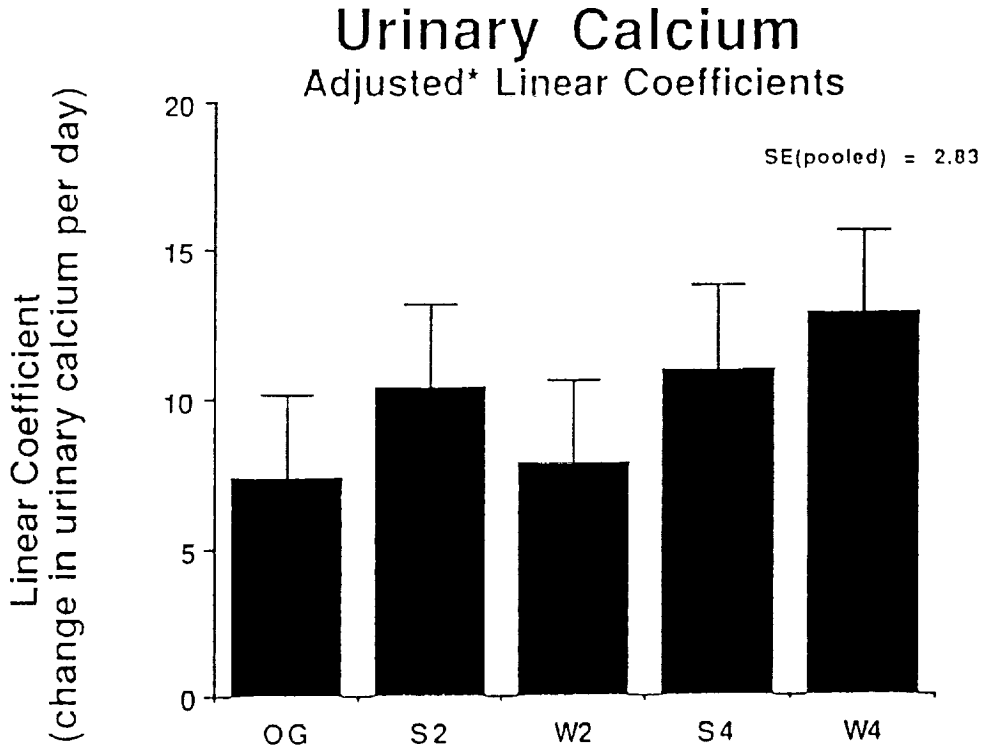


Figure 8. Actual (upper panels) and predicted (lower panel) urinary calcium by treatment condition and HDBR days. Values for actual and predicted urinary Ca are means; values for actual urinary Ca (% change) are means ± SE. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days. 0G, S2, S4, and W4 denote respectively the no treatment and the 2 hr stand, 2 hr walk, 4 hr stand, and 4 hr walk treatment conditions.



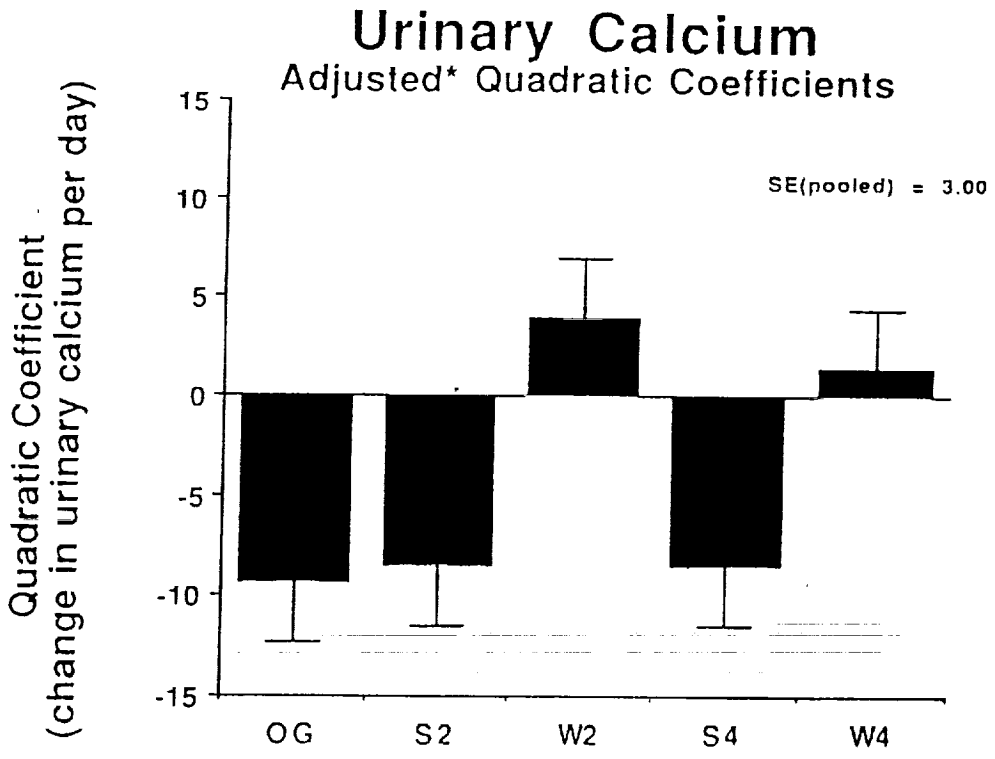
* Adjusted for Pre-Bedrest Values. Overall F test for treatment differences (ANCOVA) = 0.545; df = 4, 29; P = .7038.

Treatment	Adjusted Mean Linear Coefficients	Approximate 95% Confidence Interval	
		Lower Limit	Upper Limit
OG	7.35	1.56	13.14
S2	10.38	4.59	16.12
W2	7.82	2.03	13.61
S4	10.99	5.20	16.78
W4	12.88	7.09	18.67

Pairwise Comparisons (OG to Other Treatments)

OG versus:	Difference	t(29)	P
S2	-3.03	-0.727	.4733
W2	-0.48	-0.109	.9142
S4	-3.64	-0.807	.4262
W4	-5.54	-1.190	.2433

Figure 9. Linear change in urinary calcium by treatment conditions during HDBR. 0G, S2, W2, S2, and W4 denote respectively the no treatment and the 2 hr stand, 2 hr walk, 4 hr stand, and 4 hr walk treatment conditions. Values are means ± SE (pooled).



* Adjusted for Pre-Bedrest Values. Overall F test for treatment differences (ANCOVA) = 3.82; df = 1, 29; P = .0130.

Treatment	Adjusted Mean Quadratic Coefficients	Approximate 95% Confidence Interval	
		Lower Limit	Upper Limit
OG	-9.36	-15.50	-3.23
S2	-8.55	-14.69	-2.42
W2	3.98	-2.46	10.12
S4	-8.57	-14.71	-2.44
W4	1.49	-4.65	7.63

Pairwise Comparisons (OG to Other Treatments)

OG versus:	Difference	t(29)	P
S2	-0.795	-0.18	.8580
W2	-13.346	-2.72	.0109
S4	-0.816	-0.17	.8652
W4	-10.850	-2.34	.0262

Figure 10. Quadratic change in urinary calcium by treatment conditions during HDBR. 0G, S2, W2, S4, and W4 denote respectively the no treatment and the 2 hr stand, 2 hr walk, 4 hr stand, and 4 hr walk treatment conditions. Values are means ± SE (pooled).

In summary, the two walking conditions attenuated the increase in Ca output seen in the 0 G and standing conditions. The 0 G and standing conditions showed a steady increase in Ca excretion across HDBR which levelled off by HDBR day 4. The walking conditions showed very little trend as Ca output did not increase, and remained relatively stable and comparable to values obtained prior to HDBR (ambulatory control day).

Conclusions

Can cardiovascular deconditioning be attenuated with periodic exposure to +1 G_z? The answer seems to depend on which physiological variable is being evaluated and how cardiovascular adaptation is defined. The results of this study indicate that cardiovascular changes attributable to HDBR can be attenuated to some degree by periodic +1 G_z gravitational field (standing). Mild activity within this field did seem to augment the effects of this countermeasure although orthostatic intolerance was attenuated to a greater extent by standing than walking. Although this may at first seem surprising, the specificity of the treatment in the standing conditions may have allowed the subjects to maintain their orthostatic tolerance in response to the tilt test, since standing imposed a greater orthostatic challenge than walking because walking contributes to venous return via the skeletal muscle pump.

Although HR and BP were not restored completely to pre-HDBR levels by any of the four treatments during HDBR, the response (survival rate) to the tilt test in the subjects when they stood 2 or 4 hr/day did return to what was typically observed during their ambulatory control, pre-HDBR tilt tests. The control of BP during orthostatic challenge involves complex physiological mechanisms. The results here suggest that orthostatic intolerance can be controlled even when peripheral cardiovascular measures are altered. Indeed it is controlled because of appropriate cardiovascular responses (Convertino, 1993). Compensatory mechanisms clearly allow for some alterations in such cardiovascular indexes without complete loss of the ability to maintain adequate head level pressures. The data also indicate that the orthostatic response in these subjects following HDBR is mostly compensated for by an increase in HR. Changes in BP were far less than those seen for HR and in most cases fell within the control limits.

A summary of the results is given in table 3. No single treatment was most effective across all dependent variables. The results suggest that the preventive effects of different countermeasures are system specific. As expected, Ca balance responded favorably to activity in +1 G_z whereas orthostatic tolerance and PV were less dependent on activity and more dependent on the orthostatic stimulus provided by the $+G_z$ field. It is not known whether muscle and bone require additional G force intensity over and above that provided by standing or whether they respond specifically to activity whatever the G field. The momentary high G stress and muscle activity provided by walking seem to be important components for maintaining bone density and fitness (Whalen et al., 1988).

In most cases, differences between the 2 and 4 hr exposures were small. This suggests that 2 hr/day of standing or walking would be sufficient to counteract the negative effects of microgravity. In the case of Ca excretion, less than 2 hr of walking may suffice. The most efficient time schedule for this 2 hr of activity needs further investigation. Should the countermeasures be given in one 2-hr dosage or should dosages of shorter duration (as we did here) be given throughout the day? There is ample evidence throughout physiology that systems respond to signal and intensity change rather than to the duration of the stimulus. Factors such as fatigue, crew work

Table 3. Summary of results. S2, S4, W2, and W4 denote the 2 hr stand, 4 hr stand, 2 hr walk, and 4 hr walk treatment conditions

	S2	S4	W2	W4
Orthostatic intolerance	++	+++	+	o
Peak $\dot{V}O_2$	+	++	+++	+++
Plasma volume	o	+++	o	+++
Urinary calcium excretion (4 day)	o	o	+++	+++

+++ Most effective.
++ Effective.
+ Partially effective.
o Not effective.

schedules, and crew size in the real environment of spaceflight will also need to be considered. Using centrifugation to increase the intensity of the G stimulus further introduces the possibility of undesirable Coriolis side effects. Ideally the shorter exposures would work best from a flight logistics, psychological, and compliance perspective. Future studies in this field must assess comprehensive physiological changes if they are to contribute to our understanding of G stimulus requirements.

The most effective and physiologically comprehensive G replacement treatment is one that is most like what we experience in our everyday life on Earth, including both passive G_z and G_z with activity. What is surprising is how little of that exposure the human body seems to need to maintain normal health. Whatever the eventual optimal protocol, the present findings clearly emphasize that periodic G_z exposure can adequately prevent deconditioning associated with simulating the effects of weightlessness.

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Appendix: Data Tables

Height, cm					
Subject No.	0G	1GS4	1GW4	1GS2	1GW2
435	178	178	178	178	178
439	188	188	188	188	188
434	174	174	174	174	174
420	188	188	188	188	188
243	183	183	183	183	183
279	182	182	182		
405	177	177	177	177	177
394	177	177	177	177	177
249	188	188	188	188	188
MEAN	182	182	182	182	182
SE	2	2	2	2	2

Age, yr					
Subject No.	0G	1GS4	1GW4	1GS2	1GW2
435	37	37	37	37	37
439	40	41	40	41	41
434	35	36	36	36	36
420	46	47	46	47	47
243	31	31	32	32	32
279	33	33	33		
405	42	42	42	42	42
394	38	38	38	39	38
249	35	35	35	36	36
MEAN	37	38	38	39	39
SE	2	2	1	2	2

Weight, kg (Pre-HDBR)					
Subject No.	0G	1GS4	1GW4	1GS2	1GW2
435	73.44	74.82	75.81	76.65	78.00
439	93.39	97.73	94.22	101.00	102.09
434	94.20	92.47	93.70	95.31	93.57
420	85.97	86.56	86.85	86.14	86.95
243	79.20	80.11	80.30	76.67	80.47
279	81.18	81.43	81.89		
405	86.28	87.42	87.73	85.75	85.96
394	76.32	76.42	74.61	77.70	77.86
249	74.48	74.48	76.39	74.46	74.11
MEAN	82.72	83.49	83.50	84.21	84.88
SE	2.58	2.71	2.50	3.44	3.30

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment condition and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions.

Daily Weight, kg						
	0G	0G	0G	0G	0G	0G
Subject No.	C1	BR1	BR2	BR3	BR4	R+1
435	73.44	74.12	73.07	72.53	72.29	70.99
439	93.39	93.90	92.95	92.19	91.83	90.02
434	94.20	95.12	94.20	93.35	92.95	91.30
420	85.97	87.91	85.88	85.67	85.26	85.06
243	79.20	79.02	78.63	78.63	78.35	78.34
279	81.18	80.83	80.19	80.34	80.23	80.09
405	86.28	86.03	85.81	85.78	85.98	85.16
394	76.32	76.30	75.86	75.16	74.81	74.94
249	74.48	74.25	73.93	74.05	73.24	73.09
MEAN	82.72	83.05	82.28	81.97	81.66	81.00
SE	2.58	2.69	2.62	2.57	2.59	2.44

Daily Weight, kg						
	1GS4	1GS4	1GS4	1GS4	1GS4	1GS4
Subject No.	C1	BR1	BR2	BR3	BR4	R+1
435	74.82	75.03	74.84	75.32	73.65	73.56
439	97.73	97.10	97.15	96.47	95.97	96.37
434	92.47	92.08	92.46	92.55	91.87	91.78
420	86.56	86.33	86.74	87.18	86.59	86.59
243	80.11	80.09	80.92	79.88	79.53	78.47
279	81.43	81.84	81.30	81.41	80.98	79.88
405	87.42	87.71	87.34	88.03	87.15	86.76
394	76.42	76.15	75.97	75.72	74.96	74.95
249	74.48	74.46	74.13	74.00	74.08	73.88
MEAN	83.49	83.42	83.43	83.40	82.75	82.47
SE	2.71	2.65	2.69	2.69	2.70	2.76

Daily Weight, kg						
	1GW4	1GW4	1GW4	1GW4	1GW4	1GW4
Subject No.	C1	BR1	BR2	BR3	BR4	R+1
435	75.81	75.59	75.65	75.53	75.13	74.12
439	94.22	95.87	93.21	92.67	92.40	92.46
434	93.70	93.13	93.07	92.51	92.31	91.79
420	86.85	86.11	86.61	86.19	84.52	84.62
243	80.30	79.96	79.73	79.73	79.25	79.17
279	81.89	80.81	81.56	81.27	80.65	80.22
405	87.73	86.34	85.98	85.94	85.52	84.87
394	74.61	74.82	74.08	74.32	73.93	73.62
249	76.39	75.96	74.98	74.37	74.35	74.20
MEAN	83.50	83.18	82.76	82.50	82.01	81.67
SE	2.50	2.57	2.47	2.41	2.40	2.43

0G, 1GS4, and 1GW4 denote respectively the no treatment condition and the 4 hr stand and 4 hr walk treatment conditions. C1, BR1, BR2, BR3, BR4, and R+1 denote ambulatory control, HDBR, and recovery days.

Daily Weight, kg						
	1GS2	1GS2	1GS2	1GS2	1GS2	1GS2
Subject No.	C1	BR1	BR2	BR3	BR4	R+1
435	76.65	76.87	77.16	76.87	76.54	76.29
439	101.00	100.97	101.07	100.39	100.20	99.58
434	95.31	95.29	95.22	95.04	94.15	94.31
420	86.14	86.91	86.10	86.40	85.99	85.96
243	76.67	76.76	76.95	77.35	76.48	76.48
279						
405	85.75	85.37	85.15	85.04	84.75	84.41
394	77.70	77.53	78.27	78.24	77.27	76.95
249	74.46	74.64	73.71	74.23	73.75	73.72
MEAN	84.21	84.29	84.20	84.20	83.64	83.46
SE	3.44	3.43	3.43	3.33	3.36	3.33

Daily Weight, kg						
	1GW2	1GW2	1GW2	1GW2	1GW2	1GW2
Subject No.	C1	BR1	BR2	BR3	BR4	R+1
435	78.00	77.66	77.99	77.23	77.26	76.52
439	102.09	100.94	100.44	100.23	99.82	99.18
434	93.57	92.93	93.39	93.05	92.45	92.12
420	86.95	87.34	86.98	86.68	86.39	86.58
243	80.47	79.59	79.62	79.89	79.26	79.86
279						
405	85.96	85.34	84.85	85.13	84.45	84.38
394	77.86	77.24	77.87	77.30	76.50	76.73
249	74.11	76.56	72.96	73.17	72.95	73.72
MEAN	84.88	84.70	84.26	84.09	83.64	83.64
SE	3.30	3.10	3.22	3.21	3.20	3.09

1GS2 and 1GW2 denote respectively the 2 hr stand and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, BR4, and R+1 denote ambulatory control, HDBR, and recovery days.

Peak VO2 submaximal and maximal heart rate (HR) in beats per min (bpm), where "submaximal" is HR observed after 5 min at 400 kg-m/min				
Subject No.	0G Pre-BR Submaximal	0G Pre-BR Max	0G Post-BR Submaximal	0G Post-BR Max
435	98	164	113	198
439	91	181	87	160
434	109	180	104	169
420	111	173	112	173
243	92	164	110	180
279	119	147	127	180
405	114	173	114	170
394	97	146	95	161
249	119	193	138	198
MEAN	106	169	111	177
SE	4	5	5	5

Peak VO2 submaximal and maximal heart rate (HR) in beats per min (bpm), where "submaximal" is HR observed after 5 min at 400 kg-m/min				
Subject No.	1GS4 Pre-BR Submaximal	1GS4 Pre-BR Max	1GS4 Post-BR Submaximal	1GS4 Post-BR Max
435	106	169	106	170
439	105	169	101	177
434	112	169	107	167
420	129	172	118	172
243	96	167	100	178
279	124	168	118	158
405	116	172	117	167
394	93	143	95	157
249	135	189	134	200
MEAN	113	169	111	172
SE	5	4	4	4

0G and 1GS4 denote respectively the no treatment and the 4 hr stand treatment conditions. Pre-BR and Post-BR denote pre- and post-HDBR.

Peak VO2 submaximal and maximal heart rate (HR) in beats per min (bpm), where "submaximal" is HR observed after 5 min at 400 kg-m/min				
Subject No.	1GW4 Pre-BR Submaximal	1GW4 Pre-BR Max	1GW4 Post-BR Submaximal	1GW4 Post-BR Max
435	115	169	105	185
439	100	173	95	171
434	110	180	100	160
420	115	168	114	163
243	-	174	101	175
279	110	151	111	153
405	125	167	118	165
394	111	164	100	158
249	117	189	132	193
MEAN	113	171	108	169
SE	2	4	4	4

Peak VO2 submaximal and maximal heart rate (HR) in beats per min (bpm), where "submaximal" is HR observed after 5 min at 400 kg-m/min				
Subject No.	1GS2 Pre-BR Submaximal	1GS2 Pre-BR Max	1GS2 Post-BR Submaximal	1GS2 Post-BR Max
435	104	174	125	177
439	99	178	107	160
434	101	164	107	150
420	121	170	115	171
243	99	178	93	179
279				
405	101	168	116	175
394	109	153	104	175
249	127	191	140	191
MEAN	108	172	113	172
SE	4	4	5	4

1GW4 and 1GS2 denote respectively the 4 hr walk and 2 hr stand treatment conditions. Pre-BR and Post-BR denote pre- and post-HDBR.

Peak VO2 submaximal and maximal heart rate (HR) in beats per min (bpm), where "submaximal" is HR observed after 5 min at 400 kg-m/min				
Subject No.	1GW2 Pre-BR Submaximal	1GW2 Pre-BR Max	1GW2 Post-BR Submaximal	1GW2 Post-BR Max
435	102	164	118	183
439	105	168	98	170
434	99	156	100	174
420	125	174	115	187
243	107	181	100	167
279				
405	95	161	93	161
394	104	146	100	150
249	133	199	-	192
MEAN	109	169	103	173
SE	5	6	3	5

Peak VO2, L/min						
Subject No.	0G Pre-BR	0G Post-BR	1GS4 Pre-BR	1GS4 Post-BR	1GW4 Pre-BR	1GW4 Post-BR
435	2.30	1.97	2.33	2.15	2.50	2.37
439	2.87	2.38	2.88	2.64	2.69	2.47
434	2.44	1.74	2.33	2.00	2.33	2.14
420	2.03	1.81	2.10	1.95	2.15	1.97
243	3.22	2.81	3.01	2.95	3.35	3.08
279	2.27	1.80	2.48	1.98	2.21	2.00
405	3.31	2.70	3.24	2.77	2.98	2.72
394	2.58	2.22	2.81	2.18	2.76	2.15
249	2.94	2.54	3.09	2.78	3.37	2.99
MEAN	2.66	2.22	2.70	2.38	2.70	2.43
SE	0.15	0.14	0.13	0.13	0.15	0.14

0G, 1GS4, 1GW4, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, and 2 hr walk treatment conditions. Pre-BR and Post-BR denote pre- and post-HDBR.

Peak VO2, L/min				
Subject No.	1GS2 Pre-BR	1GS2 Post-BR	1GW2 Pre-BR	1GW2 Post-BR
435	2.30	2.14	2.28	2.15
439	2.84	2.51	3.10	2.65
434	2.38	2.00	2.00	2.11
420	1.99	1.98	2.01	1.90
243	3.16	2.74	3.32	3.18
279				
405	3.23	2.71	3.13	2.74
394	2.54	2.23	2.58	2.50
249	2.70	2.30	2.88	2.48
MEAN	2.64	2.33	2.66	2.46
SE	0.15	0.11	0.18	0.14

Peak VO2, ml/kg/min (Pre-HDBR)					
Subject No.	0G	1GS4	1GW4	1GS2	1GW2
435	31.8	31.7	32.9	30.0	29.3
439	30.8	29.2	28.5	27.4	30.2
434	26.0	25.0	24.8	24.9	21.4
420	23.4	24.0	24.7	23.0	23.0
243	41.1	37.5	41.8	39.9	41.3
279	27.6	30.3	27.1		
405	38.8	37.1	34.2	38.2	36.7
394	33.8	35.9	36.7	31.8	32.6
249	38.5	40.9	44.2	36.4	39.0
MEAN	32.4	32.4	32.8	31.5	31.7
SE	2.1	1.9	2.4	2.2	2.5

Peak VO2, ml/kg/min						
Subject No.	0G Pre-BR	0G Post-BR	1GS4 Pre-BR	1GS4 Post-BR	1GW4 Pre-BR	1GW4 Post-BR
435	31.8	27.3	31.7	29.2	32.9	31.6
439	30.8	25.9	29.2	27.6	28.5	26.8
434	26.0	18.8	25.0	21.9	24.8	23.3
420	23.4	21.2	24.0	22.5	24.7	23.3
243	41.1	35.9	37.5	37.1	41.8	38.9
279	27.6	22.6	30.3	24.5	27.1	24.8
405	38.8	31.5	37.1	31.9	34.2	31.9
394	33.8	29.7	35.9	29.1	36.7	29.1
249	38.5	34.8	40.9	37.5	44.2	40.3
MEAN	32.4	27.5	32.4	29.0	32.8	30.0
SE	2.1	2.0	1.9	1.9	2.4	2.1

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Pre-BR and Post-BR denote pre- and post-HDBR.

Peak VO2, ml/kg/min				
Subject No.	1GS2 Pre-BR	1GS2 Post-BR	1GW2 Pre-BR	1GW2 Post-BR
435	30.0	28.0	29.3	27.9
439	27.4	25.1	30.2	26.6
434	24.9	21.2	21.4	22.9
420	23.0	23.1	23.0	22.0
243	39.9	35.9	41.3	40.2
279				
405	38.2	32.0	36.7	32.4
394	31.8	29.0	32.6	32.7
249	36.4	31.2	39.0	34.0
MEAN	31.5	28.2	31.7	29.8
SE	2.2	1.7	2.5	2.2

Orthostatic Tolerance, no faint (NF) or faint (F plus time into tilt at which syncope occurred, rounded to nearest 15 seconds)						
Subject No.	0G Pre-BR	0G Post-BR	1GS4 Pre-BR	1GS4 Post-BR	1GW4 Pre-BR	1GW4 Post-BR
435	NF	NF	NF	NF	NF	NF
439	FLU (2:30)	F (11:15)	NF	NF	NF	F (14:15)
434	NF	NF	NF	NF	NF	NF
420	NF	NF	NF	NF	NF	F (21:00)
243	NF	F (11:00)	NF	NF	NF	NF
279	F (12:30)	F (17:30)	NF	NF	NF	F (6:30)
405	NF	F (25:00)	NF	NF	NF	NF
394	NF	F (3:30)	NF	NF	F (5:45)	NF
249	F (10:15)	F (29:45)	NF	F (14:30)	F (10:45)	F (14:30)

Orthostatic Tolerance, no faint (NF) or faint (F plus time into tilt at which syncope occurred, rounded to nearest 15 seconds)				
Subject No.	1GS2 Pre-BR	1GS2 Post-BR	1GW2 Pre-BR	1GW2 Post-BR
435	NF	NF	NF	NF
439	NF	NF	NF	F (20:15)
434	NF	NF	NF	NF
420	NF	NF	NF	NF
243	NF	NF	NF	NF
279				
405	NF	NF	NF	NF
394	NF	F (17:45)	F (10:00)	F (9:30)
249	NF	F (10:00)	F (21:00)	F (10:30)

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Pre-BR and Post-BR denote pre- and post-HDBR.

Tilt Test: Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg), Mean Arterial Pressure (mmHg), and Heart Rate (bpm) before and after a 60° head-up tilt test

0G Condition (Pre-HDBR)

Subject No.	Systolic Blood Pressure, mmHg			Diastolic Blood Pressure, mmHg		
	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	119	131	(130)	56	71	(70)
439	-	-	-	-	-	-
434	106	120	(123)	61	76	(79)
420	121	113	(113)	64	71	(71)
243	98	106	(97)	58	69	(64)
279	98	75	(83)	57	49	(54)
405	120	131	-	88	90	-
394	122	161	-	90	88	-
249	118	69	-	76	36	-
MEAN	113	113	(109)	69	69	(68)
SE	4	11	(9)	5	6	(4)

Subject No.	Mean Arterial Pressure, mmHg			Heart Rate, bpm		
	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	75	85	(85)	53	67	(71)
439	-	-	-	-	-	-
434	72	87	(90)	63	92	(93)
420	82	84	(84)	65	83	(84)
243	70	78	(72)	47	81	(77)
279	69	56	(62)	71	68	(73)
405	99	104	-	60	70	-
394	101	112	-	60	64	-
249	90	47	-	69	59	-
MEAN	82	82	(79)	61	73	(80)
SE	5	8	(5)	4	4	(4)

Pre-Tilt values are averages of measurements taken in the 15-second period preceeding one minute before start of tilt. Test End Point values are single point measurements taken at completion of the test (30 min or syncope). Parenthetic end point values are an average over the last 15 seconds prior to end of test. Pre-Tilt and Test End Point values for Subjects #249, #394, #405 for Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Heart Rate (HR) are single point hand recorded values; Mean Arterial Pressure (MAP) for these subjects was calculated using the formula: MAP = (SBP - DBP)/3 + DBP. Measurements for Subject #439 were not used: data was deleted because subject had fever and fainted at 2:30 min.

Tilt Test: Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg), Mean Arterial Pressure (mmHg), and Heart Rate (bpm) before and after a 60° head-up tilt test						
0G Condition (Post-HDBR)						
	Systolic Blood Pressure, mmHg			Diastolic Blood Pressure, mmHg		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	125	118	(118)	71	68	(68)
439	117	96	(96)	72	66	(66)
434	113	97	(97)	56	67	(67)
420	116	106	(109)	54	77	(78)
243	111	73	(59)	62	50	(43)
279	96	114	(100)	49	77	(67)
405	107	77	(78)	84	72	(69)
394	131	96	(103)	69	52	(58)
249	112	118	(112)	65	69	(68)
MEAN	114	99	(97)	65	66	(65)
SE	3	5	(6)	4	3	(3)
	Mean Arterial Pressure, mmHg			Heart Rate, bpm		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	87	80	(80)	60	104	(104)
439	87	73	(73)	69	85	(85)
434	70	75	(75)	65	108	(108)
420	73	83	(86)	66	111	(111)
243	77	56	(47)	50	90	(99)
279	61	87	(76)	77	124	(117)
405	93	72	(71)	67	44	(70)
394	87	62	(69)	63	83	(83)
249	81	88	(85)	77	96	(92)
MEAN	80	75	(74)	66	94	(97)
SE	3	4	(4)	3	8	(5)

Pre-Tilt values are averages of measurements taken in the 15-second period preceeding one minute before start of tilt. Test End Point values are single point measurements taken at completion of the test (30 min or syncope). Parenthetic end point values are an average over the last 15 seconds prior to end of test. Test End Point values for Subjects #439, #435, #434 are averages of measurements taken in the final 15-sec period of the test before completion of the test.

Tilt Test: Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg), Mean Arterial Pressure (mmHg), and Heart Rate (bpm) before and after a 60° head-up tilt test						
S4 Condition (Pre-HDBR)						
	Systolic Blood Pressure, mmHg			Diastolic Blood Pressure, mmHg		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	120	138	(136)	78	89	(88)
439	112	136	(137)	52	83	(82)
434	88	112	(122)	36	73	(72)
420	98	148	(141)	48	99	(94)
243	119	139	(130)	74	86	(84)
279	118	135	(131)	60	81	(78)
405	128	170	(172)	81	113	(113)
394	132	175	(175)	85	115	(115)
249	126	123	(122)	84	88	(88)
MEAN	116	142	(141)	66	92	(90)
SE	5	7	(7)	6	5	(5)
	Mean Arterial Pressure, mmHg			Heart Rate, bpm		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	94	104	(102)	56	70	(73)
439	70	97	(97)	61	79	(78)
434	47	82	(83)	53	87	(80)
420	65	114	(107)	64	98	(99)
243	87	97	(94)	51	63	(75)
279	75	94	(91)	82	102	(104)
405	98	130	(131)	60	67	(67)
394	101	133	(133)	60	69	(69)
249	100	100	(99)	80	102	(101)
MEAN	82	106	(104)	63	82	(83)
SE	6	6	(6)	4	5	(5)

Pre-Tilt values are averages of measurements taken in the 15-second period preceeding one minute before start of tilt. Test End Point values are single point measurements taken at completion of the test (30 min or syncope). Parenthetic end point values are an average over the last 15 seconds prior to end of test. Test End Point values for Subject #394 are averages of measurements taken in the final 15-sec period of the test before completion of the test.

Tilt Test: Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg), Mean Arterial Pressure (mmHg), and Heart Rate (bpm) before and after a 60° head-up tilt test						
S4 Condition (Post-HDBR)						
	Systolic Blood Pressure, mmHg			Diastolic Blood Pressure, mmHg		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	118	81	(92)	58	55	(60)
439	98	133	(136)	55	85	(88)
434	102	101	(98)	42	61	(58)
420	107	142	(136)	64	95	(92)
243	97	106	(107)	57	69	(71)
279	121	122	(125)	76	95	(97)
405	115	148	(147)	84	105	(104)
394	121	142	(143)	75	94	(95)
249	119	119	(100)	84	90	(84)
MEAN	111	122	(120)	66	83	(83)
SE	3	7	(7)	5	6	(6)
	Mean Arterial Pressure, mmHg			Heart Rate, bpm		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	76	62	(69)	68	104	(104)
439	69	98	(101)	68	87	(89)
434	58	70	(68)	56	102	(101)
420	81	110	(105)	64	94	(92)
243	70	78	(80)	61	95	(99)
279	89	103	(105)	72	116	(116)
405	97	119	(118)	62	75	(74)
394	90	107	(107)	60	86	(86)
249	98	98	(88)	73	112	(90)
MEAN	81	94	(93)	65	97	(95)
SE	5	6	(6)	2	4	(4)

Pre-Tilt values are averages of measurements taken in the 15-second period preceeding one minute before start of tilt. Test End Point values are single point measurements taken at completion of the test (30 min or syncope). Parenthetic end point values are an average over the last 15 seconds prior to end of test.

Tilt Test: Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg), Mean Arterial Pressure (mmHg), and Heart Rate (bpm) before and after a 60° head-up tilt test						
W4 Condition (Pre-HDBR)						
	Systolic Blood Pressure, mmHg			Diastolic Blood Pressure, mmHg		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	138	155	(158)	92	109	(112)
439	114	137	(136)	65	87	(87)
434	108	132	(132)	61	89	(89)
420	134	133	(125)	86	91	(87)
243	124	145	-	56	88	-
279	99	128	-	48	84	-
405	138	165	(165)	101	117	(117)
394	141	62	(67)	77	32	(35)
249	154	58	(62)	96	32	(35)
MEAN	128	124	(121)	76	81	(80)
SE	6	13	(15)	6	10	(13)
	Mean Arterial Pressure, mmHg			Heart Rate, bpm		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	109	124	(127)	56	70	(67)
439	81	100	(101)	60	78	(79)
434	72	97	(97)	61	84	(84)
420	102	102	(98)	74	94	(92)
243	79	107	-	-	76	-
279	60	99	-	77	81	-
405	114	134	(134)	52	66	(66)
394	97	40	(43)	63	64	(67)
249	115	41	(44)	70	37	(38)
MEAN	92	94	(92)	64	72	(70)
SE	7	11	(14)	3	5	(7)

Pre-Tilt values are averages of measurements taken in the 15-second period preceeding one minute before start of tilt. Test End Point values are single point measurements taken at completion of the test (30 min or syncope). Parenthetic end point values are an average over the last 15 seconds prior to end of test. Test End Point values for Subjects #434, #405 are averages of last 15 second measurements. Pre-Tilt and Test End Point values for Subject #243 and Test End Point values for Subject #279 for Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Heart Rate (HR) are single point hand recorded values; Mean Arterial Pressure (MAP) for these subjects was calculated according to the formula: MAP = (SBP - DBP)/3 + DBP.

Tilt Test: Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg), Mean Arterial Pressure (mmHg), and Heart Rate (bpm) before and after a 60° head-up tilt test						
W4 Condition (Post-HDBR)						
	Systolic Blood Pressure, mmHg			Diastolic Blood Pressure, mmHg		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	120	131	(127)	65	74	(76)
439	101	103	(105)	55	67	(69)
434	100	115	(109)	60	71	(72)
420	101	61	(61)	58	43	(42)
243	85	83	(92)	47	65	(70)
279	82	66	(65)	45	38	(39)
405	129	141	(141)	93	108	(109)
394	133	164	(160)	77	112	(108)
249	134	119	(119)	71	66	(66)
MEAN	109	109	(109)	63	72	(72)
SE	7	12	(11)	5	8	(8)
	Mean Arterial Pressure, mmHg			Heart Rate, bpm		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	83	88	(89)	68	94	(94)
439	70	75	(77)	64	85	(88)
434	71	81	(80)	68	92	(94)
420	74	49	(49)	63	72	(75)
243	59	69	(76)	53	110	(111)
279	56	45	(47)	59	86	(85)
405	106	117	(118)	65	76	(79)
394	93	125	(121)	67	92	(89)
249	91	86	(85)	73	56	(56)
MEAN	78	82	(82)	64	85	(86)
SE	6	9	(9)	2	5	(5)

Pre-Tilt values are averages of measurements taken in the 15-second period preceeding one minute before start of tilt. Test End Point values are single point measurements taken at completion of the test (30 min or syncope). Parenthetic end point values are an average over the last 15 seconds prior to end of test.

Tilt Test: Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg), Mean Arterial Pressure (mmHg), and Heart Rate (bpm) before and after a 60° head-up tilt test						
S2 Condition (Pre-HDBR)						
	Systolic Blood Pressure, mmHg			Diastolic Blood Pressure, mmHg		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	120	153	(151)	77	97	(96)
439	98	154	(158)	60	93	(94)
434	95	129	(129)	52	78	(83)
420	105	161	(157)	53	84	(90)
243	117	131	(140)	57	67	(75)
279						
405	108	147	(148)	71	94	(96)
394	141	174	(180)	76	99	(106)
249	104	143	(140)	60	89	(92)
MEAN	111	149	(150)	63	88	(92)
SE	5	5	(5)	4	4	(3)
	Mean Arterial Pressure, mmHg			Heart Rate, bpm		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	90	114	(112)	57	80	(80)
439	70	109	(110)	56	74	(73)
434	63	90	(94)	57	70	(80)
420	70	106	(109)	66	89	(91)
243	74	81	(90)	49	71	(75)
279						
405	86	111	(114)	56	62	(62)
394	95	121	(128)	58	69	(69)
249	76	103	(104)	72	90	(91)
MEAN	78	104	(108)	59	76	(78)
SE	4	5	(4)	2	4	(4)

Pre-Tilt values are averages of measurements taken in the 15-second period preceeding one minute before start of tilt. Test End Point values are single point measurements taken at completion of the test (30 min or syncope). Parenthetic end point values are an average over the last 15 seconds prior to end of test.

Tilt Test: Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg), Mean Arterial Pressure (mmHg), and Heart Rate (bpm) before and after a 60° head-up tilt test						
S2 Condition (Post-HDBR)						
	Systolic Blood Pressure, mmHg			Diastolic Blood Pressure, mmHg		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	112	138	(128)	60	83	(82)
439	105	100	(105)	54	52	(58)
434	92	101	(91)	56	56	(61)
420	113	135	(143)	49	82	(85)
243	122	117	(114)	80	95	(95)
279						
405	109	133	(135)	69	89	(94)
394	133	97	(209)	96	82	(156)
249	107	77	(79)	63	50	(51)
MEAN	112	112	(126)	66	74	(85)
SE	4	8	(14)	5	6	(12)
	Mean Arterial Pressure, mmHg			Heart Rate, bpm		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	76	97	(93)	61	108	(110)
439	69	63	(69)	61	87	(86)
434	65	67	(68)	62	88	(99)
420	69	95	(100)	67	110	(112)
243	89	100	(101)	65	100	(103)
279						
405	84	104	(106)	61	84	(81)
394	108	86	(170)	67	77	(96)
249	77	58	(61)	78	110	(100)
MEAN	80	84	(96)	65	96	(98)
SE	5	6	(12)	2	5	(4)

Pre-Tilt values are averages of measurements taken in the 15-second period preceeding one minute before start of tilt. Test End Point values are single point measurements taken at completion of the test (30 min or syncope). Parenthetic end point values are an average over the last 15 seconds prior to end of test.

Tilt Test: Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg), Mean Arterial Pressure (mmHg), and Heart Rate (bpm) before and after a 60° head-up tilt test

W2 Condition (Pre-HDBR)

Subject No.	Systolic Blood Pressure, mmHg			Diastolic Blood Pressure, mmHg		
	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	117	164	(168)	67	90	(96)
439	117	161	(155)	69	96	(98)
434	85	106	(102)	41	57	(63)
420	95	141	(144)	53	90	(91)
243	98	136	(139)	46	78	(76)
279						
405	109	152	(156)	60	82	(87)
394	144	78	(84)	82	42	(44)
249	115	112	(114)	66	56	(57)
MEAN	110	131	(133)	61	74	(77)
SE	6	11	(10)	5	7	(7)

Subject No.	Mean Arterial Pressure, mmHg			Heart Rate, bpm		
	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	85	114	(119)	58	75	(74)
439	80	109	(111)	62	80	(79)
434	53	68	(72)	56	80	(81)
420	69	105	(107)	55	75	(78)
243	61	89	(89)	44	71	(65)
279						
405	77	104	(107)	53	64	(63)
394	102	51	(54)	58	68	(67)
249	83	75	(77)	69	65	(65)
MEAN	76	89	(92)	57	72	(72)
SE	5	8	(8)	3	2	(3)

Pre-Tilt values are averages of measurements taken in the 15-second period preceeding one minute before start of tilt. Test End Point values are single point measurements taken at completion of the test (30 min or syncope). Parenthetic end point values are an average over the last 15 seconds prior to end of test.

Tilt Test: Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg), Mean Arterial Pressure (mmHg), and Heart Rate (bpm) before and after a 60° head-up tilt test						
W2 Condition (Post-HDBR)						
	Systolic Blood Pressure, mmHg			Diastolic Blood Pressure, mmHg		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	106	145	(147)	61	77	(87)
439	115	110	(115)	74	73	(73)
434	109	117	-	68	79	-
420	102	133	(138)	57	81	(91)
243	113	127	(123)	62	88	(86)
279						
405	95	136	(136)	58	82	(88)
394	128	107	(118)	68	65	(73)
249	108	68	(77)	52	40	(46)
MEAN	110	118	(122)	63	73	(78)
SE	3	8	(9)	3	5	(6)
	Mean Arterial Pressure, mmHg			Heart Rate, bpm		
Subject No.	Pre-Tilt	Test End Point		Pre-Tilt	Test End Point	
435	73	97	(104)	67	82	(89)
439	84	85	(84)	72	93	(86)
434	82	92	-	-	104	
420	74	99	(107)	67	89	(90)
243	77	99	(96)	55	98	(94)
279						
405	71	98	(101)	58	74	(76)
394	84	76	(85)	65	87	(89)
249	69	48	(55)	75	88	(88)
MEAN	77	87	(90)	66	89	(87)
SE	2	6	(7)	3	3	(2)

Pre-Tilt values are averages of measurements taken in the 15-second period preceeding one minute before start of tilt. Test End Point values are single point measurements taken at completion of the test 30 min or syncope). Parenthetic end point values are an average over the last 15 seconds prior to end of test. Pre-Tilt and Test End Point values for Subject #434 and Test End Point values for Subject #439 for Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Heart Rate (HR) are single point hand recorded values; Mean Arterial Pressure (MAP) for these subjects was calculated according to the formula: MAP = (SBP - DBP)/3 + DBP.

Plasma Volume, ml, determined using Sephadex Column method						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	3322.4	3090.7	2993.1	2875.8	2314.6	1776.0
439	2511.2	2483.4	2862.3	2747.3	3970.1	3788.4
434	2201.1	2051.8	2204.9	2066.2	2497.2	2364.5
420	2294.1	2235.4	2332.5	2274.0	3866.8	3603.9
243	3031.6	2595.9	2990.4	3080.4	2917.5	2870.0
279	3418.6	2732.2	2286.3	2152.2	1905.8	2093.8
405	2956.4	2380.5	3370.3	2854.6	2469.1	2599.3
394	2405.8	2023.3	2065.7	2021.0	2559.0	2134.0
249	2031.1	1929.7	2361.5	2274.6	4387.9	4016.0
MEAN	2685.8	2391.4	2607.4	2482.9	2987.6	2805.1
SE	169.2	126.0	150.8	134.5	289.2	272.0

Plasma Volume, ml, determined using Sephadex Column method				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	2426.2	2241.9	2322.2	2286.3
439	2804.6	2585.4	3026.9	2968.4
434	2179.7	2093.2	2312.4	1964.0
420	2196.1	2108.5	2253.5	2189.1
243	2345.7	2291.8	2159.7	1961.3
279				
405	2957.9	2347.8	2719.7	2210.9
394	2402.3	2014.8	2299.2	2072.1
249	2194.4	1901.2	2031.8	1900.4
MEAN	2438.4	2198.1	2390.7	2194.1
SE	103.4	76.1	114.4	120.8

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Plasma Volume, ml/kg						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	45.2	42.8	40.0	39.0	30.5	23.6
439	26.9	27.0	29.3	28.6	42.1	41.0
434	23.4	22.1	23.8	22.5	26.7	25.6
420	26.7	26.2	26.9	26.3	44.5	42.6
243	38.3	33.1	37.3	38.7	36.3	36.2
279	42.1	34.1	28.1	26.6	23.3	26.0
405	34.3	27.7	38.6	32.8	28.1	30.4
394	31.5	27.0	27.0	27.0	34.3	28.9
249	27.3	26.3	31.7	30.7	57.4	54.0
MEAN	32.8	29.6	31.4	30.2	35.9	34.3
SE	2.5	2.0	1.9	1.9	3.6	3.4

Plasma Volume, ml/kg				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	31.7	29.3	29.8	29.6
439	27.8	25.8	29.6	29.7
434	22.9	22.2	24.7	21.2
420	25.5	24.5	25.9	25.3
243	30.6	30.0	26.8	24.7
279				
405	34.5	27.7	31.6	26.2
394	30.9	26.1	29.5	27.1
249	29.5	25.8	27.4	26.1
MEAN	29.2	26.4	28.2	26.2
SE	1.3	0.9	0.8	1.0

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Blood Hematocrit, Hct (%)						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	47.0	52.5	49.0	52.0	48.0	50.5
439	41.5	45.5	43.5	43.0	42.0	44.0
434	46.0	49.5	44.5	45.5	45.0	45.5
420	41.5	41.0	40.0	38.0	38.0	38.0
243	45.0	47.5	45.1	45.0	44.0	45.0
279	46.0	47.0	46.0	45.5	43.5	44.0
405	38.0	41.5	36.9	38.5	39.0	40.0
394	43.0	48.0	46.5	47.0	45.0	45.0
249	42.0	47.0	45.5	46.0	45.0	44.5
MEAN	43.3	46.6	44.1	44.5	43.3	44.1
SE	1.0	1.2	1.2	1.4	1.1	1.2

Blood Hematocrit, Hct (%)				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	48.5	50.0	48.0	47.5
439	41.8	44.0	42.0	44.0
434	38.8	41.5	43.0	47.0
420	38.0	40.0	39.0	40.5
243	45.0	48.0	44.0	48.5
279				
405	39.5	43.5	38.8	41.5
394	45.0	49.0	46.0	48.8
249	45.0	47.5	45.0	46.0
MEAN	42.7	45.4	43.2	45.5
SE	1.3	1.3	1.1	1.1

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Blood Volume, ml						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	5805.4	5918.1	5401.7	5459.0	4109.7	3286.2
439	4035.0	4238.2	4737.7	4513.4	6426.1	6318.3
434	3785.9	3733.6	3705.4	3526.2	4229.0	4035.4
420	3686.2	3565.8	3667.5	3476.0	5910.7	5508.9
243	5134.0	4572.3	5072.0	5216.5	4865.7	4860.3
279	5880.0	4774.0	3932.4	3673.1	3154.5	3492.1
405	4519.1	3825.0	5074.1	4394.0	3827.5	4086.9
394	3952.4	3592.5	3581.0	3531.3	4333.6	3614.0
249	3287.6	3371.8	4030.3	3912.3	7430.8	6748.9
MEAN	4454.0	4176.8	4355.8	4189.1	4920.8	4661.2
SE	315.1	269.6	237.2	251.1	461.7	423.9

Blood Volume, ml				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	4343.0	4113.6	4123.2	4026.9
439	4526.3	4311.9	4899.5	4950.6
434	3369.4	3363.4	3798.9	3431.8
420	3356.9	3315.3	3493.3	3466.8
243	3972.4	4069.2	3601.9	3510.8
279				
405	4617.8	3886.1	4204.1	3552.5
394	4068.2	3636.2	3954.6	3727.3
249	3716.2	3348.7	3440.8	3268.7
MEAN	3996.3	3755.6	3939.5	3741.9
SE	172.9	138.9	169.4	190.3

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Blood Volume, ml/kg						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	79.0	81.9	72.2	74.1	54.2	43.7
439	43.2	46.2	48.5	47.0	68.2	68.4
434	40.2	40.2	40.1	38.4	45.1	43.7
420	42.9	41.8	42.4	40.1	68.1	65.2
243	64.8	58.4	63.3	65.6	60.6	61.3
279	72.4	59.5	48.3	45.4	38.5	43.3
405	52.4	44.5	58.0	50.4	43.6	47.8
394	51.8	48.0	46.9	47.1	58.1	48.9
249	44.1	46.0	54.1	52.8	97.3	90.8
MEAN	54.5	51.8	52.6	51.2	59.3	57.0
SE	4.7	4.4	3.5	3.9	5.9	5.3

Blood Volume, ml/kg				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	56.7	53.7	52.9	52.1
439	44.8	43.0	48.0	49.6
434	35.4	35.7	40.6	37.1
420	39.0	38.6	40.2	40.1
243	51.8	53.2	44.8	44.3
279				
405	53.9	45.9	48.9	42.1
394	52.4	47.1	50.8	48.7
249	49.9	45.4	46.4	44.8
MEAN	48.0	45.3	46.6	44.9
SE	2.7	2.2	1.6	1.8

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Plasma AVP, pg/ml						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	0.95	1.55	1.10	1.60	2.80	1.35
439	0.95	1.15	1.30	1.65	0.75	1.70
434	1.80	2.15	1.70	1.40	1.45	1.70
420	2.20	2.85	1.95	1.65	5.80	5.40
243	1.40	1.40	1.25	0.90	1.35	1.25
279	3.20	2.55	2.55	2.30	2.45	1.90
405	0.65	0.50	0.85	0.75	0.85	1.15
394	6.65	3.05	4.35	3.45	5.85	4.70
249	2.30	2.50	1.65	2.25	1.85	2.30
MEAN	2.23	1.97	1.86	1.77	2.57	2.38
SE	0.61	0.29	0.35	0.27	0.65	0.52

Plasma AVP, pg/ml				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	1.55	1.05	1.80	1.45
439	1.10	1.05	0.95	2.05
434	1.05	1.20	1.00	0.95
420	2.85	2.20	1.55	1.75
243	1.15	2.05	1.30	1.45
279				
405	0.70	0.95	0.80	1.05
394	3.10	2.15	3.15	4.15
249	2.10	1.80	2.30	2.20
MEAN	1.70	1.56	1.61	1.88
SE	0.31	0.19	0.28	0.36

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Plasma AVP, pg/ml						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	0.70	1.00	1.27	1.00	1.07	0.67
439	0.47	0.37	0.43	0.50	0.53	0.60
434	1.07	1.17	1.70	0.63	0.80	0.93
420	1.10	1.30	2.00	1.87	2.70	1.50
243	0.95	1.20	0.80	0.57	1.10	0.53
279	1.20	1.10	0.70	3.30	1.57	2.80
405	0.73	0.43	0.57	0.47	0.40	0.50
394	1.33	2.00	2.67	1.67	3.30	3.07
249	2.57	1.73	1.47	2.03	2.23	2.80
MEAN	1.12	1.14	1.29	1.34	1.52	1.49
SE	0.20	0.18	0.25	0.32	0.34	0.37

0G, 1GS4, and 1GW4 denote respectively the no treatment and the 4 hr stand and 4 hr walk treatment conditions. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1. Plasma AVP (Supine Control and BR1 4-HR) data were not analyzed for the 2 hr stand and 2 hr walk conditions.

Plasma Norepinephrine (NE), pg/ml						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	232	349	260	336	291	290
439	202	283	152	-	119	167
434	171	203	262	309	173	318
420	295	220	230	191	211	170
243	217	183	254	186	227	167
279	451	526	431	335	332	263
405	142	177	113	115	118	116
394	94	234	189	390	406	289
249	209	253	199	295	224	267
MEAN	223.7	269.8	232.2	269.6	233.4	227.4
SE	34.1	36.7	30.1	33.4	32.0	24.1

Plasma Norepinephrine (NE), pg/ml						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	304	279	413	332	383	261
439	360	167	416	153	131	123
434	211	159	276	228	251	224
420	293	261	268	214	297	233
243	208	160	240	264	401	214
279	494	346	498	410	281	283
405	141	188	106	143	183	172
394	349	244	281	469	463	391
249	329	148	309	233	339	235
MEAN	298.8	216.9	311.9	271.8	303.2	237.3
SE	34.6	22.9	38.6	37.1	35.4	24.8

0G, 1GS4, and 1GW4 denote respectively the no treatment and the 4 hr stand and 4 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1. Plasma NE data were not analyzed for the 2 hr stand and 2 hr walk conditions.

Plasma Epinephrine (E), pg/ml						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	61	134	40	53	55	45
439	309	30	587	136	653	50
434	22	107	22	107	39	32
420	310	146	109	53	57	24
243	25	24	107	17	470	43
279	432	68	224	45	29	35
405	41	49	115	46	-	655
394	26	31	-	51	34	118
249	38	39	45	182	63	46
MEAN	140.4	69.8	156.1	76.7	175.0	116.4
SE	53.9	15.8	65.5	17.8	86.2	67.9

Plasma Epinephrine (E), pg/ml						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	-	29	64	58	109	29
439	48	24	19	61	235	301
434	158	41	158	41	53	41
420	116	73	150	36	-	82
243	41	23	49	37	30	29
279	57	44	75	122	61	43
405	95	78	109	139	41	174
394	18	52	-	15	-	125
249	25	222	74	84	51	52
MEAN	69.8	65.1	87.3	65.9	82.9	97.3
SE	17.3	20.7	17.1	13.9	27.1	30.2

0G, 1GS4, and 1GW4 denote respectively the no treatment and the 4 hr stand and 4 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from samples drawn on HDBR day 4. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1. Plasma E data were not analyzed for the 2 hr stand and 2 walk conditions.

PRA, ng/ml/hr						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	0.47	3.46	0.22	1.72	0.92	1.20
439	1.14	4.59	2.35	1.28	1.17	2.12
434	0.75	3.81	0.61	1.84	0.33	1.75
420	0.80	0.57	1.02	0.44	0.66	1.38
243	0.48	1.25	0.46	0.63	0.71	1.09
279	1.16	1.46	1.37	0.99	1.19	1.93
405	0.18	0.66	0.55	0.39	0.30	0.84
394	0.18	0.97	0.09	0.86	0.77	1.14
249	0.32	2.98	0.13	1.22	0.51	1.17
MEAN	0.61	2.19	0.76	1.04	0.73	1.40
SE	0.13	0.51	0.24	0.17	0.11	0.14

PRA, ng/ml/hr				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	0.57	2.07	1.14	0.34
439	1.17	1.87	0.60	3.23
434	1.17	2.46	0.71	2.05
420	0.12	1.11	0.62	0.93
243	0.71	3.74	0.44	1.89
279				
405	0.36	0.53	0.26	0.82
394	0.51	3.09	0.32	1.38
249	0.26	4.80	0.32	1.01
MEAN	0.61	2.46	0.55	1.46
SE	0.14	0.49	0.10	0.32

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

PRA, ng/ml/hr						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	0.74	0.26	0.56	0.25	0.91	0.40
439	1.04	0.60	2.15	2.33	0.94	0.87
434	0.87	1.75	1.39	1.24	0.60	1.47
420	0.90	0.36	0.65	0.57	3.43	0.86
243	0.68	0.54	0.58	0.34	0.81	1.30
279	1.04	1.05	2.01	1.31	1.17	1.36
405	0.01	0.20	0.24	0.59	0.32	0.12
394	0.29	0.18	0.33	0.14	0.75	0.68
249	0.22	0.28	0.30	0.26	0.49	0.66
MEAN	0.64	0.58	0.91	0.78	1.05	0.86
SE	0.13	0.17	0.25	0.24	0.31	0.15

PRA, ng/ml/hr				
Subject No.	1GS2 Supine Control	1GS2 BR1 4-HR	1GW2 Supine Control	1GW2 BR1 4-HR
435	1.15	0.23	1.28	0.52
439	1.22	1.03	1.00	1.70
434	0.88	0.90	1.22	2.24
420	0.51	0.51	1.23	0.72
243	0.74	0.61	0.44	0.57
279				
405	0.18	0.16	0.12	0.19
394	0.61	0.71	0.41	0.56
249	0.80	0.42	0.24	0.01
MEAN	0.76	0.57	0.74	0.81
SE	0.12	0.11	0.17	0.27

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Plasma Aldosterone, ng/dl						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	13.0	45.2	15.8	21.7	15.8	22.7
439	6.0	35.7	27.5	9.4	9.2	18.8
434	7.9	35.3	11.4	18.9	8.4	18.2
420	20.9	20.6	14.4	14.2	10.4	15.5
243	12.4	12.3	14.1	8.6	9.6	12.7
279	22.4	21.6	39.0	19.9	20.0	28.3
405	6.0	11.6	6.4	6.2	7.0	6.1
394	5.8	8.4	4.8	17.6	15.2	16.6
249	13.9	31.4	14.6	30.8	18.4	29.7
MEAN	12.0	24.7	16.4	16.4	12.7	18.7
SE	2.1	4.3	3.6	2.6	1.6	2.5

Plasma Aldosterone, ng/dl				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	20.2	27.8	20.3	32.7
439	11.8	16.7	11.6	31.9
434	11.2	19.5	12.8	26.5
420	8.4	17.3	10.9	16.2
243	17.2	14.6	6.1	13.5
279				
405	6.6	8.1	4.7	5.9
394	6.3	10.4	5.3	13.6
249	12.1	27.0	15.5	19.9
MEAN	11.7	17.7	10.9	20.0
SE	1.7	2.5	1.9	3.4

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Plasma Aldosterone, ng/dl						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	39.5	9.1	41.9	8.6	34.8	11.4
439	14.5	5.0	15.3	9.8	18.4	7.6
434	11.2	8.6	7.4	12.7	6.2	8.4
420	11.3	5.3	14.0	11.4	16.2	11.5
243	6.0	5.1	6.4	8.8	14.7	9.8
279	22.2	9.2	36.5	13.1	15.0	12.3
405	5.3	4.9	9.7	8.0	7.0	7.1
394	4.8	4.3	7.3	6.0	10.9	7.8
249	10.8	7.8	14.0	7.5	11.0	7.4
MEAN	13.9	6.6	16.9	9.5	14.9	9.3
SE	3.7	0.7	4.4	0.8	2.8	0.7

Plasma Aldosterone, ng/dl				
Subject No.	1GS2 Supine Control	1GS2 BR1 4-HR	1GW2 Supine Control	1GW2 BR1 4-HR
435	49.4	9.8	48.3	10.4
439	10.7	5.4	18.0	5.7
434	11.7	7.5	20.0	7.9
420	5.2	9.9	26.3	15.8
243	9.6	13.0	5.9	7.3
279				
405	5.8	4.3	6.4	5.3
394	9.9	7.1	5.1	10.8
249	9.9	7.6	8.5	8.3
MEAN	14.0	8.1	17.3	8.9
SE	5.1	1.0	5.2	1.2

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Plasma Cortisol, µg/100 ml						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	17.9	16.0	17.9	18.7	18.4	18.0
439	-	17.2	18.3	17.9	11.3	17.6
434	19.2	27.0	20.2	23.2	17.8	14.4
420	23.5	20.9	18.1	21.1	7.4	19.0
243	21.8	18.8	18.0	20.2	19.9	19.1
279	15.4	18.1	21.0	17.7	17.6	19.0
405	15.6	17.1	17.2	14.5	15.7	9.6
394	12.0	14.2	10.1	13.6	11.9	15.3
249	18.1	17.3	19.6	21.2	18.5	20.7
MEAN	17.9	18.5	17.8	18.7	15.4	17.0
SE	1.3	1.2	1.1	1.1	1.4	1.1

Plasma Cortisol, µg/100 ml				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	21.3	19.2	20.6	18.4
439	17.2	13.1	15.7	17.6
434	19.1	12.7	21.1	19.4
420	15.2	18.5	14.4	16.5
243	22.7	21.5	15.2	15.4
279				
405	15.6	15.1	12.5	7.2
394	16.7	13.4	14.1	14.6
249	14.8	16.2	17.2	16.8
MEAN	17.8	16.2	16.4	15.7
SE	1.0	1.1	1.1	1.3

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Plasma Cortisol, µg/100 ml						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	9.7	9.9	14.0	11.0	13.0	11.6
439	20.8	11.2	7.5	13.1	7.0	10.3
434	8.5	9.9	6.2	12.1	7.5	10.7
420	7.2	5.4	11.3	9.5	6.9	7.6
243	7.9	11.2	6.7	16.9	7.7	14.8
279	10.8	8.1	11.1	9.8	12.4	13.3
405	10.6	10.1	10.1	7.7	8.2	6.7
394	13.6	11.2	17.1	11.7	16.7	9.7
249	10.6	6.2	10.7	6.6	9.1	6.7
MEAN	11.1	9.2	10.5	10.9	9.8	10.2
SE	1.4	0.7	1.2	1.0	1.1	0.9

Plasma Cortisol, µg/100 ml				
Subject No.	1GS2 Supine Control	1GS2 BR1 4-HR	1GW2 Supine Control	1GW2 BR1 4-HR
435	13.3	12.1	14.5	11.7
439	4.4	6.2	10.8	8.2
434	7.1	7.1	8.7	7.4
420	6.6	9.1	13.2	7.3
243	13.4	18.1	9.4	10.3
279				
405	11.0	7.9	11.5	9.1
394	11.8	14.0	16.1	11.4
249	11.3	7.3	9.9	7.8
MEAN	9.9	10.2	11.8	9.2
SE	1.2	1.5	0.9	0.6

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Plasma ANP, pg/ml						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	60.24	14.28	50.82	24.22	36.15	15.07
439	58.56	23.01	46.64	34.97	28.76	20.98
434	19.86	2.69	25.42	9.62	24.76	11.40
420	45.84	25.84	26.87	48.07	-	39.83
243	-	36.24	41.32	47.77	56.08	16.54
279	6.93	4.95	23.53	10.86	20.14	14.23
405	40.94	11.55	43.18	18.93	36.73	13.42
394	31.24	6.17	19.07	14.58	11.57	4.34
249	60.14	19.53	64.26	33.72	59.65	2.69
MEAN	40.47	16.03	37.90	26.97	34.23	15.39
SE	7.03	3.70	5.02	4.96	5.92	3.60

Plasma ANP, pg/ml				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	33.73	48.68	40.80	14.08
439	56.02	24.54	40.61	17.11
434	21.65	13.82	30.86	25.87
420	31.19	23.97	56.24	47.47
243	32.57	14.97	57.28	24.48
279				
405	38.33	19.76	41.70	9.27
394	12.03	10.22	18.20	4.43
249	34.77	5.50	37.11	15.70
MEAN	32.54	20.18	40.35	19.80
SE	4.50	4.68	4.50	4.68

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Plasma ANP, pg/ml						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	46.43	67.99	58.03	62.68	72.04	58.31
439	38.96	53.89	30.72	50.77	26.86	38.19
434	19.42	27.01	44.48	36.42	18.86	19.64
420	43.35	79.91	47.61	66.85	42.04	-
243	50.00	-	38.84	47.29	43.36	54.81
279	10.19	20.51	7.00	9.63	24.27	17.68
405	38.92	41.08	32.28	39.14	29.74	24.31
394	28.54	23.37	18.49	16.52	17.71	31.96
249	46.00	81.80	48.39	37.45	48.93	58.97
MEAN	35.76	49.45	36.20	40.75	35.98	37.98
SE	4.52	8.89	5.33	6.34	5.83	6.14

Plasma ANP, pg/ml				
Subject No.	1GS2 Supine Control	1GS2 BR1 4-HR	1GW2 Supine Control	1GW2 BR1 4-HR
435	44.95	59.77	40.49	20.40
439	41.16	83.35	41.63	39.57
434	43.66	20.25	36.87	22.36
420	20.28	58.14	63.69	61.46
243	26.49	40.06	51.76	67.91
279				
405	52.20	40.37	34.83	36.52
394	14.91	20.82	28.08	18.57
249	42.93	78.15	38.23	52.13
MEAN	35.82	50.11	41.95	39.87
SE	4.74	8.45	3.90	6.75

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Plasma Sodium (Na), mEq/L						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	138.7	138.0	137.5	136.7	136.8	135.5
439	138.9	139.3	136.1	136.2	137.6	138.3
434	138.2	137.6	138.1	137.5	139.4	138.3
420	139.6	137.8	137.5	134.8	138.2	140.4
243	139.0	136.9	138.4	139.5	136.4	135.4
279	138.6	136.5	138.4	138.9	138.1	136.1
405	138.7	136.9	139.6	139.4	139.1	138.9
394	138.0	135.9	139.9	137.8	139.0	137.7
249	138.3	135.3	137.2	136.5	137.8	138.4
MEAN	138.7	137.1	138.1	137.5	138.0	137.7
SE	0.2	0.4	0.4	0.5	0.3	0.6

Plasma Sodium (Na), mEq/L				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	130.1	132.1	128.4	128.3
439	133.7	134.8	130.8	130.7
434	135.2	131.3	131.0	129.7
420	131.0	132.7	133.1	136.1
243	132.4	132.0	136.5	132.2
279				
405	134.9	133.8	130.9	129.7
394	131.6	128.5	135.4	131.4
249	131.4	130.6	134.5	132.1
MEAN	132.5	132.0	132.6	131.3
SE	0.7	0.7	1.0	0.8

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Plasma Sodium (Na), mEq/L						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	140.3	138.4	136.8	138.1	136.7	136.1
439	138.3	137.9	138.3	135.8	137.1	138.7
434	138.0	139.1	139.7	135.2	139.0	130.9
420	139.9	136.1	132.4	136.9	139.5	139.4
243	138.4	135.0	139.0	137.2	131.3	134.7
279	137.3	134.7	137.9	138.0	134.8	135.5
405	139.1	131.0	140.4	140.2	138.3	131.9
394	137.6	129.8	139.0	130.2	140.2	138.9
249	137.1	130.3	134.1	138.3	138.0	138.5
MEAN	138.4	134.7	137.5	136.7	137.2	136.1
SE	0.4	1.2	0.9	0.9	0.9	1.0

Plasma Sodium (Na), mEq/L				
Subject No.	1GS2 Supine Control	1GS2 BR1 4-HR	1GW2 Supine Control	1GW2 BR1 4-HR
435	132.6	133.7	129.9	129.2
439	133.2	134.6	130.4	130.8
434	135.4	129.8	130.6	131.1
420	132.4	132.1	130.6	134.9
243	131.8	129.8	136.0	129.4
279				
405	178.4	131.3	131.5	129.0
394	131.4	127.5	136.2	128.8
249	132.1	131.6	134.5	128.1
MEAN	138.4	131.3	132.5	130.2
SE	5.7	0.8	0.9	0.8

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Plasma Potassium (K), mEq/L						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	4.07	4.41	4.41	4.43	4.07	4.43
439	4.12	4.26	4.03	3.95	4.13	4.02
434	4.41	4.35	4.47	4.55	4.52	4.53
420	4.34	4.24	4.06	3.91	4.25	3.96
243	4.20	4.08	4.06	3.96	4.05	3.81
279	4.25	4.36	4.33	4.17	3.96	3.94
405	4.22	4.42	4.29	4.04	4.45	4.18
394	3.79	3.71	4.09	3.71	3.79	3.57
249	4.31	4.43	4.25	4.31	4.15	4.13
MEAN	4.19	4.25	4.22	4.11	4.15	4.06
SE	0.06	0.08	0.06	0.09	0.08	0.10

Plasma Potassium (K), mEq/L				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	4.14	4.26	4.28	3.83
439	3.99	3.91	3.77	3.87
434	4.02	4.13	3.96	4.10
420	3.99	3.81	3.92	4.00
243	3.78	3.60	3.94	3.81
279				
405	3.71	4.01	4.03	3.95
394	3.29	3.83	3.58	3.87
249	3.90	3.82	4.10	3.87
MEAN	3.85	3.92	3.95	3.91
SE	0.09	0.07	0.07	0.03

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Plasma Potassium (K), mEq/L						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	4.06	3.91	4.09	4.62	3.81	4.22
439	4.39	3.84	4.04	3.75	4.45	4.11
434	4.68	4.03	4.47	3.99	4.29	3.87
420	4.10	3.99	3.86	3.96	3.75	4.08
243	4.46	3.81	4.35	4.01	4.08	4.14
279	4.47	3.89	4.26	4.21	4.02	3.89
405	4.35	4.10	4.28	5.11	4.54	4.17
394	3.74	3.90	4.06	4.30	3.83	4.32
249	4.45	3.60	4.68	4.01	4.41	3.94
MEAN	4.30	3.90	4.23	4.22	4.13	4.08
SE	0.09	0.05	0.08	0.14	0.10	0.05

Plasma Potassium (K), mEq/L				
Subject No.	1GS2 Supine Control	1GS2 BR1 4-HR	1GW2 Supine Control	1GW2 BR1 4-HR
435	3.97	3.96	3.77	3.84
439	4.05	3.87	3.99	3.73
434	4.08	3.66	4.06	4.01
420	3.91	3.83	3.83	3.83
243	3.80	4.21	3.89	3.78
279				
405	4.85	3.92	3.86	3.87
394	3.70	3.97	3.69	3.92
249	3.89	3.67	4.16	3.48
MEAN	4.03	3.89	3.91	3.81
SE	0.12	0.06	0.05	0.06

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Plasma Osmolality, mOsm/kg						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	281	283	282	285	283	285
439	284	288	292	293	286	291
434	282	284	288	293	287	288
420	288	287	290	290	285	293
243	281	285	284	285	288	288
279	283	284	285	288	288	286
405	287	288	283	287	292	287
394	286	285	287	287	287	283
249	285	286	281	283	281	287
MEAN	284	286	286	288	286	288
SE	1	1	1	1	1	1

Plasma Osmolality, mOsm/kg				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	284	282	287	282
439	287	291	287	291
434	282	283	287	287
420	287	288	288	291
243	287	287	285	283
279				
405	286	286	285	283
394	289	282	283	283
249	288	282	285	281
MEAN	286	285	286	285
SE	1	1	1	1

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Plasma Osmolality, mOsm/kg						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	285	286	283	286	285	287
439	282	286	290	293	286	289
434	283	285	280	291	286	287
420	286	288	292	292	286	288
243	284	283	283	285	289	287
279	282	284	284	286	286	288
405	290	290	286	286	283	288
394	287	287	289	285	289	285
249	286	288	282	284	281	286
MEAN	285	286	285	288	286	287
SE	1	1	1	1	1	0

Plasma Osmolality, mOsm/kg				
Subject No.	1GS2 Supine Control	1GS2 BR1 4-HR	1GW2 Supine Control	1GW2 BR1 4-HR
435	285	284	284	289
439	288	288	290	289
434	284	288	289	289
420	291	284	287	288
243	285	287	285	285
279				
405	286	289	288	287
394	289	285	288	285
249	287	283	284	284
MEAN	287	286	287	287
SE	1	1	1	1

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Serum Total Protein, g/dl						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	-	-	7.5	8.0	7.8	8.0
439	-	-	7.8	8.0	7.3	8.0
434	-	-	7.8	8.0	7.3	8.3
420	7.5	7.5	7.5	8.0	-	-
243	7.5	7.8	-	-	7.3	7.5
279	8.3	8.5	-	-	8.0	8.3
405	7.3	7.8	-	-	7.5	7.8
394	7.3	8.0	7.8	9.0	-	-
249	7.3	8.3	7.3	8.0	-	-
MEAN	7.5	8.0	7.6	8.2	7.5	8.0
SE	0.2	0.1	0.1	0.2	0.1	0.1

Serum Total Protein, g/dl				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	8.0	8.2	8.0	7.9
439	7.8	8.0	8.0	8.0
434	7.4	8.1	7.8	7.9
420	7.4	7.4	7.5	7.6
243	7.4	7.4	7.3	7.4
279				
405	7.1	7.8	7.6	7.5
394	7.5	8.0	7.6	8.1
249	7.5	8.0	7.8	7.9
MEAN	7.5	7.9	7.7	7.8
SE	0.1	0.1	0.1	0.1

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4. Serum Total Protein data were not analyzed for the first HDBR exposure.

Serum Total Protein, g/dl						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	-	-	7.8	8.3	7.8	7.8
439	-	-	8.0	8.0	7.5	7.8
434	-	-	7.8	8.0	7.8	7.5
420	7.5	7.5	7.8	7.8	-	-
243	7.3	7.5	-	-	7.5	7.8
279	8.3	8.3	-	-	8.3	8.3
405	7.5	7.8	-	-	7.5	7.8
394	7.3	7.3	7.8	7.8	-	-
249	7.8	7.5	7.5	8.0	-	-
MEAN	7.6	7.7	7.8	8.0	7.7	7.8
SE	0.2	0.1	0.1	0.1	0.1	0.1

Serum Total Protein, g/dl				
Subject No.	1GS2 Supine Control	1GS2 BR1 4-HR	1GW2 Supine Control	1GW2 BR1 4-HR
435	8.2	8.1	8.2	8.0
439	7.9	7.9	8.0	8.2
434	7.8	7.6	7.9	8.1
420	7.6	7.4	7.6	7.5
243	7.2	7.6	7.4	7.6
279				
405	7.3	7.6	7.8	7.9
394	7.9	8.0	7.7	7.8
249	7.9	7.5	7.8	7.8
MEAN	7.7	7.7	7.8	7.9
SE	0.1	0.1	0.1	0.1

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1. Serum Total Protein data were not analyzed for the first HDBR exposure.

Plasma Total Cholesterol, mg/dl				
Subject No.	0G Ambulatory Control	0G BR4	1GW4 Ambulatory Control	1GW4 BR4
435	176	172	169	181
439	143	136	152	155
434	220	254	230	239
420	275	271	264	275
243	182	223	197	225
279	197	213	196	209
405	168	180	194	194
394	142	169	145	159
249	167	206	170	196
MEAN	186	203	191	204
SE	14	14	13	13

Plasma Total Cholesterol, mg/dl				
Subject No.	0G Supine Control	0G BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	170	177	177	179
439	145	143	156	160
434	232	245	253	239
420	277	279	271	285
243	183	194	199	209
279	202	200	196	199
405	181	191	205	199
394	146	149	148	152
249	177	183	173	171
MEAN	190	196	198	199
SE	14	14	14	14

0G and1GW4 denote respectively the no treatment and the 4 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Plasma HDL Cholesterol, mg/dl				
Subject No.	0G Ambulatory Control	0G BR4	1GW4 Ambulatory Control	1GW4 BR4
435	51	43	63	54
439	31	27	27	27
434	21	24	27	25
420	37	39	39	38
243	48	47	46	48
279	26	27	24	27
405	40	31	39	26
394	62	64	60	56
249	39	41	41	47
MEAN	39	38	41	39
SE	4	4	5	4

Plasma HDL Cholesterol, mg/dl				
Subject No.	0G Supine Control	0G BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	51	48	65	57
439	31	28	28	27
434	22	21	28	24
420	38	37	40	37
243	50	47	47	46
279	27	27	24	23
405	40	37	42	37
394	63	62	60	57
249	40	37	42	37
MEAN	40	38	42	38
SE	4	4	5	4

0G and1GW4 denote respectively the no treatment and the 4 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Plasma LDL Cholesterol, mg/dl				
Subject No.	0G Ambulatory Control	0G BR4	1GW4 Ambulatory Control	1GW4 BR4
435	106	105	91	110
439	80	75	83	91
434	136	160	151	167
420	201	202	178	210
243	121	167	142	166
279	140	155	136	157
405	106	111	135	143
394	67	89	76	92
249	113	151	117	138
MEAN	119	135	123	142
SE	13	14	11	13

Plasma LDL Cholesterol, mg/dl				
Subject No.	0G Supine Control	0G BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	97	96	92	93
439	86	77	83	73
434	143	105	155	129
420	194	189	179	181
243	120	125	142	147
279	143	131	133	129
405	117	114	142	118
394	68	71	78	84
249	118	121	115	108
MEAN	121	114	124	118
SE	12	12	12	11

0G and1GW4 denote respectively the no treatment and the 4 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1. Plasma LDL cholesterol values were calculated using the formula: Plasma LDL cholesterol = Plasma total cholesterol – [Plasma HDH cholesterol + (Plasma triglycerides/5)].

Plasma Triglycerides, mg/dl				
Subject No.	0G Ambulatory Control	0G BR4	1GW4 Ambulatory Control	1GW4 BR4
435	96	119	77	85
439	159	169	208	185
434	316	351	262	233
420	183	150	235	134
243	65	47	45	56
279	153	154	179	126
405	110	188	102	123
394	63	78	44	55
249	76	71	62	57
MEAN	136	147	135	117
SE	27	30	29	21

Plasma Triglycerides, mg/dl				
Subject No.	0G Supine Control	0G BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	112	163	101	143
439	138	192	225	302
434	333	594	350	432
420	224	263	262	335
243	66	110	51	79
279	160	211	195	237
405	121	202	107	222
394	75	80	51	56
249	93	127	79	131
MEAN	147	216	158	215
SE	28	51	35	42

0G and1GW4 denote respectively the no treatment and the 4 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Serum Creatinine, mg/dl						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	0.9	0.9	0.8	0.8	0.9	0.8
439	1.0	0.9	0.9	1.0	0.9	0.9
434	1.0	1.2	1.1	1.1	1.1	1.1
420	1.0	1.0	1.1	1.1	1.0	0.9
243	0.9	1.0	1.0	1.0	1.0	1.0
279	0.9	0.9	1.0	0.9	0.9	1.1
405	1.1	1.1	1.0	1.1	1.1	1.1
394	1.1	1.2	1.1	1.1	1.1	1.1
249	1.1	1.1	0.9	1.0	1.0	1.0
MEAN	1.0	1.0	1.0	1.0	1.0	1.0
SE	0.0	0.0	0.0	0.0	0.0	0.0

Serum Creatinine, mg/dl				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	0.8	0.9	0.8	0.9
439	1.0	1.1	0.9	1.0
434	1.1	1.1	1.1	1.2
420	1.0	1.0	1.0	1.1
243	1.0	1.0	1.0	1.0
279				
405	1.1	1.1	1.0	1.0
394	1.0	1.2	1.1	1.1
249	1.1	1.1	1.0	1.0
MEAN	1.0	1.1	1.0	1.0
SE	0.0	0.0	0.0	0.0

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Ambulatory Control values are from blood samples drawn on the ambulatory control day (first samples drawn that day); BR4 values are from blood samples drawn on HDBR day 4.

Serum Creatinine, mg/dl						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	0.9	0.8	0.8	0.8	0.9	0.9
439	1.1	1.0	1.0	0.9	0.9	0.9
434	0.9	1.0	1.0	1.1	1.0	1.1
420	1.0	1.0	1.2	1.1	1.1	1.0
243	0.9	1.0	0.9	1.0	1.0	1.1
279	0.9	1.0	1.0	1.0	0.9	1.0
405	1.1	1.0	1.0	1.0	1.1	1.1
394	1.1	1.1	1.1	1.1	1.1	1.0
249	1.0	1.1	1.0	1.0	1.0	1.1
MEAN	1.0	1.0	1.0	1.0	1.0	1.0
SE	0.0	0.0	0.0	0.0	0.0	0.0

Serum Creatinine, mg/dl				
Subject No.	1GS2 Supine Control	1GS2 BR1 4-HR	1GW2 Supine Control	1GW2 BR1 4-HR
435	0.9	0.8	0.9	0.9
439	1.1	1.0	0.9	0.9
434	1.1	1.1	1.0	1.2
420	1.0	1.0	1.0	1.1
243	1.0	1.0	1.0	1.0
279				
405	1.1	1.1	1.0	1.0
394	1.1	1.0	1.1	1.1
249	1.0	1.0	1.0	1.0
MEAN	1.0	1.0	1.0	1.0
SE	0.0	0.0	0.0	0.0

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. Supine Control values are from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values are from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Urinary Creatinine, mg/24 hr					
Subject No.	0G C1	0G BR1	0G BR2	0G BR3	0G BR4
435	1986	2035	1887	1838	1926
439	2023	2365	2134	2535	2228
434	2456	2698	1705	3331	2418
420	2053	2120	2094	2040	2030
243	2252	2284	2279	2157	2234
279	2432	2124	2412	2306	2136
405	2606	1654	4009	2169	2365
394	2061	2278	2209	2354	2246
249	2075	1697	1249	2591	1330
MEAN	2216	2139	2220	2369	2101
SE	76	108	252	143	109

Urinary Creatinine, mg/24 hr					
Subject No.	1GS4 C1	1GS4 BR1	1GS4 BR2	1GS4 BR3	1GS4 BR4
435	1907	1728	1799	2007	1460
439	2339	2113	2193	2295	2412
434	1954	2506	2345	2298	2484
420	2219	2027	2028	2217	2112
243	1976	2548	2564	2537	2273
279	2109	2119	2146	2426	2542
405	2138	1897	2480	4008	2738
394	1711	2283	2330	2369	2577
249	2031	2091	2119	1969	1784
MEAN	2043	2146	2223	2458	2265
SE	62	89	79	203	138

Urinary Creatinine, mg/24 hr					
Subject No.	1GW4 C1	1GW4 BR1	1GW4 BR2	1GW4 BR3	1GW4 BR4
435	1309	2459	2085	1997	1456
439	2094	2235	2276	2066	2053
434	1520	2363	2497	1689	2299
420	1925	2209	2241	2400	2035
243	2204	2265	2359	2316	2355
279	2002	2381	2540	2124	2399
405	2207	2703	1955	2267	2629
394	2576	2172	2376	2385	2659
249	2497	2349	1091	3416	1442
MEAN	2037	2348	2158	2296	2147
SE	138	54	147	159	150

0G, 1GS4, and 1GW4 denote respectively the no treatment condition and the 4 hr stand and 4 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Urinary Creatinine, mg/24 hr					
Subject No.	1GS2 C1	1GS2 BR1	1GS2 BR2	1GS2 BR3	1GS2 BR4
435	2075	1534	2132	2045	1707
439	2582	1934	2827	1778	1981
434	3000	2142	2538	2396	2346
420	2875	1867	2023	2064	2090
243	1721	2265	2225	2184	2212
279					
405	2160	2081	1778	2707	2430
394	2911	2214	2221	2091	2292
249	2516	2360	1949	2136	2197
MEAN	2480	2050	2212	2175	2157
SE	162	94	118	97	81

Urinary Creatinine, mg/24 hr					
Subject No.	1GW2 C1	1GW2 BR1	1GW2 BR2	1GW2 BR3	1GW2 BR4
435	1960	1339	2115	2069	1812
439	2420	2367	2119	2653	2252
434	2467	2656	2362	2532	2443
420	2073	1610	2463	2141	2283
243	2190	2271	2159	1924	2425
279					
405	2286	2476	2388	2093	2391
394	2750	2019	2389	2181	2330
249	2026	2035	2001	2049	2107
MEAN	2272	2097	2250	2205	2255
SE	94	157	60	89	74

1GS2 and 1GW2 denote respectively the 2 hr stand and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Glomerular Filtration Rate (GFR), dl/min						
Subject No.	0G Ambulatory Control	0G BR4	1GS4 Ambulatory Control	1GS4 BR4	1GW4 Ambulatory Control	1GW4 BR4
435	1.532	1.486	1.655	1.267	1.010	1.264
439	1.405	1.719	1.805	1.675	1.616	1.584
434	1.706	1.399	1.234	1.568	0.960	1.451
420	1.426	1.410	1.401	1.333	1.337	1.570
243	1.738	1.551	1.372	1.578	1.531	1.635
279	1.877	1.648	1.465	1.961	1.545	1.515
405	1.645	1.493	1.485	1.729	1.393	1.660
394	1.301	1.300	1.080	1.627	1.626	1.679
249	1.310	0.840	1.567	1.239	1.734	1.001
MEAN	1.549	1.427	1.452	1.553	1.417	1.484
SE	0.068	0.085	0.072	0.079	0.091	0.074

Glomerular Filtration Rate (GFR), dl/min				
Subject No.	1GS2 Ambulatory Control	1GS2 BR4	1GW2 Ambulatory Control	1GW2 BR4
435	1.801	1.317	1.701	1.398
439	1.793	1.251	1.867	1.564
434	1.894	1.481	1.557	1.414
420	1.997	1.451	1.440	1.441
243	1.195	1.536	1.521	1.684
279				
405	1.364	1.534	1.588	1.660
394	2.022	1.326	1.736	1.471
249	1.588	1.387	1.407	1.463
MEAN	1.707	1.410	1.602	1.512
SE	0.106	0.038	0.055	0.039

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. GFR values were calculated using the formula: GFR = (Urinary creatinine excretion rate/Serum creatinine)/1440. Ambulatory Control values were calculated using urinary creatinine data from the ambulatory control day and serum creatinine data from blood samples drawn on the ambulatory control day (first samples drawn that day). BR4 values were calculated using urinary creatinine data from HDBR day 4 and serum creatinine data from blood samples drawn on HDBR day 4.

Glomerular Filtration Rate (GFR), dl/min						
Subject No.	0G Supine Control	0G BR1 4-HR	1GS4 Supine Control	1GS4 BR1 4-HR	1GW4 Supine Control	1GW4 BR1 4-HR
435	1.532	1.766	1.655	1.500	1.010	1.897
439	1.277	1.642	1.624	1.630	1.616	1.725
434	1.895	1.874	1.357	1.582	1.056	1.492
420	1.426	1.472	1.284	1.280	1.215	1.534
243	1.738	1.586	1.525	1.769	1.531	1.430
279	1.877	1.475	1.465	1.472	1.545	1.653
405	1.645	1.149	1.485	1.317	1.393	1.706
394	1.301	1.438	1.080	1.441	1.626	1.508
249	1.441	1.071	1.410	1.452	1.734	1.483
MEAN	1.570	1.497	1.432	1.494	1.414	1.603
SE	0.077	0.087	0.059	0.051	0.087	0.051

Glomerular Filtration Rate (GFR), dl/min				
Subject No.	1GS2 Supine Control	1GS2 BR1 4-HR	1GW2 Supine Control	1GW2 BR1 4-HR
435	1.601	1.332	1.512	1.033
439	1.630	1.343	1.867	1.826
434	1.894	1.352	1.713	1.537
420	1.997	1.297	1.440	1.016
243	1.195	1.573	1.521	1.577
279				
405	1.364	1.314	1.588	1.719
394	1.838	1.538	1.736	1.275
249	1.747	1.639	1.407	1.413
MEAN	1.658	1.424	1.598	1.425
SE	0.096	0.048	0.057	0.106

0G, 1GS4, 1GW4, 1GS2, and 1GW2 denote respectively the no treatment and the 4 hr stand, 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. GFR values were calculated using the formula: GFR = (Urinary creatinine excretion rate/Serum creatinine)/1440. Supine Control values were calculated using urinary creatinine data from the ambulatory control day and serum creatinine data from blood samples drawn on the ambulatory control day after subjects had been lying quietly for 45 min (second samples drawn that day); BR1 4-HR values were calculated using urinary creatinine data from HDBR day 1 and serum creatinine data from blood samples drawn 4 hr after beginning HDBR on HDBR day 1.

Urinary Osmolality, mOsm/kg					
	0G	0G	0G	0G	0G
Subject No.	C1	BR1	BR2	BR3	BR4
435	547	567	539	547	707
439	326	457	798	836	862
434	396	596	686	896	705
420	579	851	935	1011	762
243	730	665	594	708	619
279	509	505	755	791	590
405	484	471	509	584	451
394	685	683	900	1015	1012
249	590	574	662	713	809
MEAN	538	597	709	789	724
SE	43	41	50	56	55

Urinary Osmolality, mOsm/kg					
	1GS4	1GS4	1GS4	1GS4	1GS4
Subject No.	C1	BR1	BR2	BR3	BR4
435	432	493	532	650	560
439	782	825	871	873	880
434	554	932	873	950	879
420	960	910	940	904	902
243	501	563	544	597	518
279	528	583	563	474	711
405	531	550	547	587	496
394	950	916	976	998	1026
249	542	644	492	669	701
MEAN	642	713	704	745	741
SE	67	60	68	63	64

Urinary Osmolality, mOsm/kg					
	1GW4	1GW4	1GW4	1GW4	1GW4
Subject No.	C1	BR1	BR2	BR3	BR4
435	385	696	969	848	688
439	487	715	890	934	931
434	622	789	950	1048	966
420	661	851	1038	1067	1066
243	588	600	738	656	900
279	400	765	714	528	987
405	416	739	793	867	671
394	996	946	1015	1069	1026
249	621	794	936	955	958
MEAN	575	766	894	886	910
SE	63	33	40	63	47

0G, 1GS4, and 1GW4 denote respectively the no treatment condition and the 4 hr stand and 4 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Urinary Osmolality, mOsm/kg					
Subject No.	1GS2 C1	1GS2 BR1	1GS2 BR2	1GS2 BR3	1GS2 BR4
435	414	421	454	558	444
439	635	637	732	703	783
434	514	546	474	577	562
420	517	447	783	671	630
243	341	329	449	427	795
279					
405	405	379	472	493	427
394	904	642	643	665	851
249	686	507	632	507	738
MEAN	552	489	580	575	654
SE	65	41	48	35	58

Urinary Osmolality, mOsm/kg					
Subject No.	1GW2 C1	1GW2 BR1	1GW2 BR2	1GW2 BR3	1GW2 BR4
435	318	515	510	760	507
439	520	726	856	914	891
434	515	834	600	606	902
420	607	763	706	869	976
243	437	437	546	392	778
279					
405	481	423	772	469	516
394	753	712	795	859	954
249	559	517	797	750	749
MEAN	524	616	698	702	784
SE	45	57	46	68	66

Urinary Cortisol, µg/24 hr					
Subject No.	0G C1	0G BR1	0G BR2	0G BR3	0G BR4
435	54.3	65.9	63.6	64.2	58.9
439	55.4	70.2	49.1	48.8	60.7
434	51.0	44.0	25.2	45.1	40.0
420	37.2	47.4	46.1	48.2	46.8
243	59.1	60.6	64.8	50.9	87.6
279	109.2	73.1	79.2	102.3	74.9
405	91.8	50.7	67.0	54.6	98.9
394	48.3	84.1	74.6	61.9	60.1
249	57.0	40.0	29.8	47.9	35.6
MEAN	62.6	59.6	55.5	58.2	62.6
SE	7.6	5.0	6.4	5.9	7.1

0G, 1GS2, and 1GW2 denote respectively the no treatment condition and the 2 hr stand and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Urinary Cortisol, µg/24 hr					
	1GS4	1GS4	1GS4	1GS4	1GS4
Subject No.	C1	BR1	BR2	BR3	BR4
435	59.3	49.4	67.4	76.8	54.2
439	39.7	34.9	43.3	45.0	49.3
434	25.5	37.7	33.2	42.0	39.4
420	58.9	46.3	39.5	80.4	47.1
243	44.0	69.0	95.3	86.8	68.1
279	64.2	79.7	67.9	90.9	91.9
405	43.1	56.8	57.8	71.7	54.4
394	41.3	57.8	50.4	74.6	62.5
249	53.4	50.3	90.2	35.7	50.0
MEAN	47.7	53.5	60.6	67.1	57.4
SE	4.1	4.8	7.3	6.9	5.1

Urinary Cortisol, µg/24 hr					
	1GW4	1GW4	1GW4	1GW4	1GW4
Subject No.	C1	BR1	BR2	BR3	BR4
435	41.1	80.5	66.7	84.6	61.4
439	37.6	32.7	39.9	36.9	45.8
434	25.0	20.2	21.5	15.8	29.5
420	35.5	31.0	29.7	37.5	46.9
243	55.6	68.3	63.5	60.3	63.8
279	61.7	68.2	82.2	56.0	97.3
405	41.5	66.8	20.2	37.8	76.7
394	68.6	57.0	60.2	59.9	77.9
249	47.5	51.5	21.5	53.2	30.6
MEAN	46.0	52.9	45.0	49.1	58.9
SE	4.6	6.9	7.8	6.5	7.6

Urinary Cortisol, µg/24 hr					
	1GS2	1GS2	1GS2	1GS2	1GS2
Subject No.	C1	BR1	BR2	BR3	BR4
435	65.5	43.9	65.2	78.3	44.4
439	34.6	29.3	45.2	16.7	28.6
434	42.9	24.5	44.9	40.5	34.5
420	46.5	38.3	31.6	37.8	41.9
243	79.6	92.9	89.5	89.9	60.0
279					
405	51.4	60.3	25.2	57.0	58.4
394	54.4	47.0	54.1	47.5	51.7
249	46.1	50.2	26.6	35.5	41.0
MEAN	52.6	48.3	47.8	50.4	45.1
SE	5.0	7.5	7.7	8.5	3.9

1GS4, 1GW4, and 1GS2 denote respectively the 4 hr stand, 4 hr walk, and 2 hr stand treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Urinary Cortisol, μg/24 hr					
	1GW2	1GW2	1GW2	1GW2	1GW2
Subject No.	C1	BR1	BR2	BR3	BR4
435	69.5	36.9	55.5	65.0	68.1
439	32.2	28.2	27.6	33.8	35.7
434	42.4	40.4	38.0	39.5	43.1
420	33.5	19.1	36.6	32.4	40.8
243	71.1	47.8	46.8	45.3	41.9
279					
405	50.2	52.2	39.1	46.8	42.7
394	67.3	40.1	61.2	42.3	48.3
249	51.3	31.7	26.6	30.4	39.1
MEAN	52.2	37.1	41.4	41.9	45.0
SE	5.6	3.8	4.4	3.9	3.5

Urinary Calcium (Ca), mg/24 hr					
	0G	0G	0G	0G	0G
Subject No.	C1	BR1	BR2	BR3	BR4
435	108.5	259.3	267.5	296.8	313.0
439	48.0	145.9	135.5	171.1	86.4
434	56.3	120.8	126.5	106.2	141.6
420	185.8	232.3	320.6	267.6	267.6
243	220.0	287.1	324.0	294.8	292.0
279	63.2	93.8	138.3	149.6	144.0
405	195.3	165.4	264.6	200.4	223.3
394	140.4	251.4	250.8	204.2	223.8
249	201.0	255.7	228.0	344.4	190.6
MEAN	135.4	201.3	228.4	226.1	209.1
SE	22.8	23.4	25.9	26.3	25.2

Urinary Calcium (Ca), mg/24 hr					
	1GS4	1GS4	1GS4	1GS4	1GS4
Subject No.	C1	BR1	BR2	BR3	BR4
435	351.5	197.7	297.5	326.6	240.8
439	173.3	220.0	212.9	280.5	291.3
434	82.0	159.0	148.2	157.1	111.0
420	183.6	258.9	248.0	319.1	285.6
243	220.8	305.3	323.8	286.9	254.8
279	85.2	154.8	163.3	148.7	136.6
405	115.5	197.0	172.4	203.3	203.0
394	153.0	177.8	181.3	276.9	211.7
249	233.8	266.4	313.6	242.3	238.2
MEAN	177.6	215.2	229.0	249.0	219.2
SE	28.2	17.3	22.9	22.0	20.6

0G, 1GS4, and 1GW2 denote respectively the no treatment condition and the 4 hr stand and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Urinary Calcium (Ca), mg/24 hr					
	1GW4	1GW4	1GW4	1GW4	1GW4
Subject No.	C1	BR1	BR2	BR3	BR4
435	223.2	300.8	133.4	339.8	-
439	130.8	196.1	181.2	168.6	197.6
434	107.1	85.2	107.3	102.8	115.7
420	187.5	205.2	226.3	357.3	250.5
243	264.0	297.5	262.8	304.0	244.8
279	271.2	163.7	135.0	128.9	114.4
405	195.1	179.3	159.2	189.2	207.7
394	139.1	171.0	216.9	227.0	223.0
249	276.0	267.3	129.6	409.5	178.6
MEAN	199.3	207.3	172.4	247.5	191.5
SE	21.3	23.4	17.6	36.3	18.6

Urinary Calcium (Ca), mg/24 hr					
	1GS2	1GS2	1GS2	1GS2	1GS2
Subject No.	C1	BR1	BR2	BR3	BR4
435	143.4	59.3	279.6	327.8	282.8
439	124.7	146.5	180.8	135.7	163.2
434	166.8	122.4	141.9	158.6	135.2
420	222.5	322.2	257.1	308.0	306.9
243	222.0	361.2	357.8	376.2	199.9
279					
405	146.9	246.8	157.2	211.0	243.5
394	308.7	235.2	254.7	266.9	253.5
249	273.3	365.1	308.4	334.4	289.2
MEAN	201.0	232.3	242.2	264.8	234.3
SE	23.5	40.5	26.9	31.0	22.0

Urinary Calcium (Ca), mg/24 hr					
	1GW2	1GW2	1GW2	1GW2	1GW2
Subject No.	C1	BR1	BR2	BR3	BR4
435	222.4	42.8	288.0	288.7	264.7
439	141.1	141.2	138.2	157.5	157.7
434	141.2	123.3	136.7	152.1	125.7
420	232.2	140.7	322.3	263.1	278.6
243	263.5	208.0	193.8	267.8	266.6
279					
405	201.0	192.2	151.4	183.2	195.7
394	276.0	177.0	229.5	232.5	228.3
249	222.3	279.8	177.4	278.3	302.4
MEAN	212.5	163.1	204.7	227.9	227.5
SE	17.7	24.5	24.7	19.7	22.1

1GW4, 1GS2, and 1GW2 denote respectively the 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Sodium (Na) Intake, mEq/24 hr					
	0G	0G	0G	0G	0G
Subject No.	C1	BR1	BR2	BR3	BR4
435	185.5	186.1	172.4	198.7	173.4
439	186.0	185.9	172.1	198.8	166.4
434	185.1	185.8	171.5	181.4	165.5
420	163.9	171.7	166.9	193.5	172.9
243	185.4	185.6	172.0	198.2	172.9
279	122.0	163.3	162.5	162.0	148.0
405	185.5	185.9	172.4	198.5	173.3
394	161.6	185.0	171.5	197.9	173.0
249	184.9	185.4	171.8	197.9	173.3
MEAN	173.3	181.6	170.3	191.9	168.7
SE	7.2	2.8	1.1	4.2	2.8

Sodium (Na) Intake, mEq/24 hr					
	1GS4	1GS4	1GS4	1GS4	1GS4
Subject No.	C1	BR1	BR2	BR3	BR4
435	176.2	172.5	198.7	186.7	168.8
439	176.4	173.0	199.0	186.9	168.5
434	167.6	200.8	185.0	171.1	184.0
420	161.8	169.3	198.0	186.1	157.5
243	167.9	201.6	185.6	171.8	188.2
279	173.8	171.9	183.6	169.4	147.0
405	175.8	172.4	198.4	186.5	168.9
394	167.9	168.6	184.9	171.3	187.7
249	175.8	111.5	198.1	186.1	168.2
MEAN	171.5	171.3	192.4	179.5	171.0
SE	1.8	8.6	2.4	2.7	4.6

Sodium (Na) Intake, mEq/24 hr					
	1GW4	1GW4	1GW4	1GW4	1GW4
Subject No.	C1	BR1	BR2	BR3	BR4
435	168.8	199.6	185.9	172.4	188.7
439	176.4	172.5	198.9	186.4	168.5
434	168.1	201.2	185.0	171.6	184.7
420	168.3	197.1	171.7	171.8	187.7
243	175.7	171.5	197.9	186.3	167.9
279	168.6	204.1	165.9	171.5	174.1
405	168.5	202.1	186.1	172.2	188.8
394	158.3	167.3	198.1	169.1	167.9
249	167.9	184.9	185.6	168.6	188.7
MEAN	169.0	188.9	186.1	174.4	179.7
SE	1.7	5.0	3.8	2.3	3.3

0G, 1GS4, and 1GW4 denote respectively the no treatment condition and the 4 hr stand and 4 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory and HDBR days.

Sodium (Na) Intake, mEq/24 hr					
	1GS2	1GS2	1GS2	1GS2	1GS2
Subject No.	C1	BR1	BR2	BR3	BR4
435	161.9	196.4	165.9	185.9	167.7
439	161.9	199.7	162.8	185.9	166.9
434	104.9	150.5	227.8	162.6	175.5
420	171.9	165.6	171.2	166.3	146.2
243	151.6	199.2	199.4	151.3	175.7
279					
405	183.4	165.9	186.0	180.7	152.1
394	151.2	196.1	203.0	162.6	148.0
249	182.8	162.6	185.4	170.3	151.6
MEAN	158.7	179.5	187.7	170.7	160.5
SE	8.9	7.1	7.7	4.4	4.3

Sodium (Na) Intake, mEq/24 hr					
	1GW2	1GW2	1GW2	1GW2	1GW2
Subject No.	C1	BR1	BR2	BR3	BR4
435	205.6	200.0	165.9	185.9	167.7
439	205.6	199.4	165.9	186.0	166.9
434	202.3	199.1	153.3	185.2	165.8
420	161.7	183.7	165.6	171.1	162.6
243	143.3	157.5	199.4	165.6	175.7
279					
405	152.2	199.5	199.7	162.8	175.9
394	142.9	148.4	168.0	162.6	167.5
249	182.8	153.3	158.4	180.4	151.6
MEAN	174.6	180.1	172.0	175.0	166.7
SE	9.8	8.2	6.2	3.7	2.7

Urinary Sodium (Na), mEq/24 hr					
	0G	0G	0G	0G	0G
Subject No.	C1	BR1	BR2	BR3	BR4
435	167.7	196.7	229.7	176.4	127.8
439	81.6	163.4	138.7	139.6	87.5
434	163.0	173.5	162.7	149.2	92.6
420	153.5	152.8	163.4	150.8	117.2
243	174.8	220.9	143.4	147.7	95.0
279	137.3	189.0	143.8	160.5	113.3
405	265.6	196.7	192.7	158.5	157.2
394	128.8	283.7	162.0	136.3	120.2
249	198.8	221.6	168.6	200.7	87.8
MEAN	163.5	199.8	167.2	157.7	111.0
SE	16.9	13.1	9.5	6.7	7.7

0G, 1GS2, and 1GW2 denote respectively the no treatment condition and the 2 hr stand and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Urinary Sodium (Na), mEq/24 hr					
Subject No.	1GS4 C1	1GS4 BR1	1GS4 BR2	1GS4 BR3	1GS4 BR4
435	167.6	193.7	213.8	162.0	137.3
439	105.7	135.5	171.4	192.0	186.0
434	166.8	173.0	166.9	159.2	142.4
420	79.9	101.7	155.3	192.4	132.5
243	85.4	160.8	160.1	159.8	142.1
279	62.9	138.1	155.6	160.1	125.5
405	105.3	164.4	178.9	180.5	164.8
394	142.2	199.5	159.5	156.2	147.6
249	181.9	189.0	165.6	145.1	116.7
MEAN	122.0	161.7	169.7	167.5	143.9
SE	14.5	10.7	6.1	5.6	7.0

Urinary Sodium (Na), mEq/24 hr					
Subject No.	1GW4 C1	1GW4 BR1	1GW4 BR2	1GW4 BR3	1GW4 BR4
435	118.3	279.4	171.4	161.9	167.4
439	124.6	175.7	198.8	142.4	145.3
434	167.4	145.7	159.7	99.3	154.4
420	90.1	131.3	123.7	159.4	119.7
243	137.0	190.1	176.5	131.9	107.3
279	145.5	137.2	160.4	133.0	142.3
405	142.7	219.6	151.0	127.9	170.8
394	80.5	177.6	131.2	105.6	137.4
249	179.4	217.1	68.1	176.7	73.1
MEAN	131.7	186.0	149.0	137.6	135.3
SE	10.8	15.8	12.6	8.5	10.3

Urinary Sodium (Na), mEq/24 hr					
Subject No.	1GS2 C1	1GS2 BR1	1GS2 BR2	1GS2 BR3	1GS2 BR4
435	117.4	198.0	208.8	157.7	136.4
439	141.8	188.1	202.7	126.5	126.0
434	195.2	159.1	233.4	211.8	106.6
420	184.1	184.5	117.7	149.0	121.8
243	98.4	164.3	195.4	186.6	83.4
279					
405	182.0	233.1	138.3	169.0	162.2
394	258.0	189.0	232.6	132.4	112.2
249	212.3	281.1	232.9	202.1	108.9
MEAN	173.6	199.7	195.2	166.9	119.7
SE	18.5	14.1	15.7	11.1	8.2

1GS4, 1GW4, and 1GS2 denote respectively the 4 hr stand, 4 hr walk, and 2 hr stand treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Urinary Sodium (Na), mEq/24 hr					
Subject No.	1GW2 C1	1GW2 BR1	1GW2 BR2	1GW2 BR3	1GW2 BR4
435	122.9	183.3	188.6	111.8	149.0
439	191.2	215.1	148.2	133.7	129.0
434	159.4	169.6	155.1	140.7	114.7
420	109.1	129.3	167.9	128.1	146.1
243	240.6	179.3	167.6	142.1	87.6
279					
405	202.2	215.5	157.1	166.1	137.3
394	244.3	157.4	184.0	160.5	89.8
249	196.0	222.7	141.1	150.7	139.5
MEAN	183.2	184.0	163.7	141.7	124.1
SE	17.6	11.5	5.9	6.2	8.6

Sodium (Na) Balance, mEq/24 hr, determined from Urinary Sodium (Na) minus Sodium (Na) Intake					
Subject No.	0G C1	0G BR1	0G BR2	0G BR3	0G BR4
435	17.8	-10.6	-57.3	22.3	45.6
439	104.4	22.5	33.4	59.2	78.9
434	22.1	12.3	8.8	32.2	72.9
420	10.4	18.9	3.5	42.7	55.7
243	10.6	-35.3	28.6	50.5	77.9
279	-15.3	-23.7	18.7	1.5	34.7
405	-80.1	-10.8	-20.3	40.0	16.1
394	32.8	-98.7	9.5	61.6	52.8
249	-13.9	-36.2	3.2	-2.8	85.5
MEAN	9.9	-18.0	3.1	34.1	57.8
SE	16.2	12.5	9.2	7.8	7.7

0G and 1GW2 denote respectively the no treatment condition and the 2 hr walk treatment condition.
C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Sodium (Na) Balance, mEq/24 hr, determined from Urinary Sodium (Na) minus Sodium (Na) Intake					
Subject No.	1GS4 C1	1GS4 BR1	1GS4 BR2	1GS4 BR3	1GS4 BR4
435	8.6	-21.2	-15.1	24.7	31.5
439	70.7	37.5	27.6	-5.1	-17.5
434	0.8	27.8	18.1	11.9	41.6
420	81.9	67.6	42.7	-6.3	25.0
243	82.5	40.8	25.5	12.0	46.1
279	110.9	33.8	28.0	9.3	21.5
405	70.5	8.0	19.5	6.0	4.1
394	25.7	-30.9	25.4	15.1	40.1
249	-6.1	-77.5	32.5	41.0	51.5
MEAN	49.5	9.5	22.7	12.1	27.1
SE	14.2	15.0	5.3	4.8	7.4

Sodium (Na) Balance, mEq/24 hr, determined from Urinary Sodium (Na) minus Sodium (Na) Intake					
Subject No.	1GW4 C1	1GW4 BR1	1GW4 BR2	1GW4 BR3	1GW4 BR4
435	50.5	-79.8	14.5	10.5	21.3
439	51.8	-3.2	0.1	44.0	23.2
434	0.7	55.5	25.3	72.3	30.3
420	78.2	65.8	48.0	12.4	68.0
243	38.7	-18.6	21.4	54.4	60.6
279	23.1	66.9	5.5	38.5	31.8
405	25.8	-17.5	35.1	44.3	18.0
394	77.8	-10.3	66.9	63.5	30.5
249	-11.5	-32.2	117.5	-8.1	115.6
MEAN	37.2	3.0	37.1	36.9	44.4
SE	10.4	16.7	12.2	8.9	10.6

1GS4 and 1GW4 denote respectively the 4 hr stand and 4 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Sodium (Na) Balance, mEq/24 hr, determined from Urinary Sodium (Na) minus Sodium (Na) Intake					
	1GS2	1GS2	1GS2	1GS2	1GS2
Subject No.	C1	BR1	BR2	BR3	BR4
435	44.5	-1.6	-42.9	28.2	31.3
439	20.1	11.6	-39.9	59.4	40.9
434	-90.3	-8.6	-5.6	-49.2	68.9
420	-12.2	-18.9	53.5	17.3	24.4
243	53.2	34.9	4.0	-35.3	92.3
279					
405	1.4	-67.2	47.7	11.7	-10.1
394	-106.8	7.1	-29.6	30.2	35.8
249	-29.5	-118.5	-47.5	-31.8	42.7
MEAN	-15.0	-20.2	-7.5	3.8	40.8
SE	20.7	17.5	14.2	13.5	10.7

Sodium (Na) Balance, mEq/24 hr, determined from Urinary Sodium (Na) minus Sodium (Na) Intake					
	1GW2	1GW2	1GW2	1GW2	1GW2
Subject No.	C1	BR1	BR2	BR3	BR4
435	82.7	16.7	-22.7	74.1	18.7
439	14.4	-15.6	17.7	52.3	37.9
434	42.9	29.5	-1.8	44.5	51.1
420	52.6	54.4	-2.3	43.0	16.5
243	-97.3	-21.8	31.8	23.5	88.1
279					
405	-50.0	-16.0	42.6	-3.3	38.6
394	-101.4	-9.0	-16.0	2.1	77.7
249	-13.2	-69.4	17.3	29.7	12.1
MEAN	-8.7	-3.9	8.3	33.2	42.6
SE	24.5	13.3	8.1	9.1	10.0

1GS2 and 1GW2 denote respectively the 2 hr stand and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Potassium (K) Intake, mEq/24 hr					
Subject No.	0G C1	0G BR1	0G BR2	0G BR3	0G BR4
435	92.2	86.0	85.8	83.4	90.8
439	92.0	84.4	83.9	81.8	90.6
434	92.0	85.8	82.6	66.1	86.1
420	75.1	79.9	87.3	78.1	87.7
243	89.0	83.7	87.3	79.7	88.6
279	83.8	57.4	81.5	64.1	84.0
405	92.3	89.6	84.9	85.5	93.0
394	87.3	86.1	81.3	83.8	91.7
249	90.1	87.6	83.7	84.9	94.2
MEAN	88.2	82.3	84.3	78.6	89.6
SE	1.9	3.2	0.8	2.7	1.1

Potassium (K) Intake, mEq/24 hr					
Subject No.	1GS4 C1	1GS4 BR1	1GS4 BR2	1GS4 BR3	1GS4 BR4
435	95.2	89.6	83.4	88.3	100.9
439	93.4	84.0	85.7	91.7	99.1
434	96.1	84.8	86.1	80.9	74.6
420	88.6	81.9	82.4	88.8	97.2
243	97.3	87.6	83.7	83.5	90.3
279	92.9	83.9	71.4	85.5	94.6
405	94.8	84.4	81.5	85.3	99.5
394	97.4	83.5	81.0	84.7	82.9
249	91.7	86.1	81.4	86.3	98.9
MEAN	94.2	85.1	81.8	86.1	93.1
SE	0.9	0.8	1.4	1.1	3.0

Potassium (K) Intake, mEq/24 hr					
Subject No.	1GW4 C1	1GW4 BR1	1GW4 BR2	1GW4 BR3	1GW4 BR4
435	100.9	88.3	89.6	85.8	92.6
439	93.4	89.6	81.8	86.4	99.2
434	99.0	86.2	76.8	86.1	78.2
420	97.3	86.3	80.1	82.9	89.1
243	93.0	82.1	84.7	89.8	97.3
279	95.7	84.5	83.8	80.7	84.5
405	99.1	88.3	86.0	88.1	91.2
394	89.4	82.4	80.4	84.9	96.5
249	97.5	87.7	84.0	82.4	90.6
MEAN	96.1	86.2	83.0	85.2	91.0
SE	1.2	0.9	1.2	1.0	2.2

0G, 1GS4, and 1GW4 denote respectively the no treatment condition and the 4 hr stand and 4 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Potassium (K) Intake, mEq/24 hr					
Subject No.	1GS2 C1	1GS2 BR1	1GS2 BR2	1GS2 BR3	1GS2 BR4
435	99.2	88.5	83.5	89.5	93.8
439	99.3	87.5	83.6	90.5	89.0
434	81.5	102.9	96.3	82.2	92.9
420	86.6	82.2	81.8	87.4	96.5
243	98.7	104.9	87.1	81.0	93.0
279					
405	90.6	83.5	89.1	89.5	101.1
394	96.4	97.6	87.2	82.2	83.1
249	88.0	82.2	87.5	83.2	98.8
MEAN	92.5	91.2	87.0	85.7	93.5
SE	2.4	3.3	1.6	1.4	2.0

Potassium (K) Intake, mEq/24 hr					
Subject No.	1GW2 C1	1GW2 BR1	1GW2 BR2	1GW2 BR3	1GW2 BR4
435	101.1	89.4	83.5	89.5	93.8
439	101.2	112.8	83.6	89.2	89.1
434	99.7	86.0	81.3	87.3	85.6
420	97.6	83.3	82.2	82.2	80.4
243	98.7	102.7	87.1	81.9	93.0
279					
405	99.5	106.5	87.8	83.8	93.6
394	97.5	102.9	83.4	82.0	89.0
249	89.9	81.3	80.3	89.3	98.8
MEAN	98.2	95.6	83.7	85.7	90.4
SE	1.3	4.2	0.9	1.2	2.0

Urinary Potassium (K), mEq/24 hr					
Subject No.	0G C1	0G BR1	0G BR2	0G BR3	0G BR4
435	70.2	54.1	66.5	58.2	63.2
439	39.5	35.0	46.6	68.8	75.4
434	59.0	51.3	63.8	91.8	67.9
420	59.9	59.6	59.7	63.0	57.5
243	85.4	70.2	70.3	72.4	75.0
279	78.1	59.8	55.3	67.5	50.0
405	79.5	55.5	69.0	70.1	70.8
394	30.0	48.8	56.2	66.4	63.8
249	67.8	45.5	36.8	73.0	65.1
MEAN	63.3	53.3	58.2	70.1	65.4
SE	6.2	3.3	3.7	3.1	2.7

0G, 1GS2, and 1GW2 denote respectively the no treatment condition and the 2 hr stand and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 and denote ambulatory control and HDBR days.

C-2

Urinary Potassium (K), mEq/24 hr					
	1GS4	1GS4	1GS4	1GS4	1GS4
Subject No.	C1	BR1	BR2	BR3	BR4
435	82.8	66.4	70.0	71.5	59.7
439	91.0	78.2	71.0	74.6	69.6
434	48.7	98.4	79.0	86.0	90.1
420	61.2	51.8	58.0	67.3	59.2
243	66.2	70.6	74.7	86.2	65.5
279	51.3	75.2	61.2	65.0	73.4
405	62.9	67.0	79.3	77.8	69.4
394	31.8	51.3	59.2	68.3	81.1
249	53.1	51.5	59.2	61.2	74.9
MEAN	61.0	67.8	68.0	73.1	71.4
SE	6.0	5.1	2.9	3.0	3.3

Urinary Potassium (K), mEq/24 hr					
	1GW4	1GW4	1GW4	1GW4	1GW4
Subject No.	C1	BR1	BR2	BR3	BR4
435	67.3	102.8	73.2	65.4	65.2
439	64.3	77.5	93.0	70.1	62.1
434	56.5	84.9	77.9	61.8	89.6
420	60.6	105.0	63.8	93.2	65.5
243	69.1	78.1	78.7	69.6	77.2
279	42.7	69.1	65.7	57.3	74.2
405	78.0	118.8	66.4	65.4	82.9
394	47.5	64.6	80.1	79.3	84.7
249	47.8	87.0	38.9	130.3	66.6
MEAN	59.3	87.5	70.9	76.9	74.2
SE	3.9	6.0	5.0	7.5	3.3

Urinary Potassium (K), mEq/24 hr					
	1GS2	1GS2	1GS2	1GS2	1GS2
Subject No.	C1	BR1	BR2	BR3	BR4
435	82.3	69.1	69.2	67.9	57.2
439	62.6	62.7	71.7	47.2	56.5
434	70.8	59.4	82.5	77.0	68.6
420	84.4	55.4	51.3	65.9	61.5
243	55.7	74.8	80.5	61.2	59.6
279					
405	63.7	62.8	50.1	86.9	77.9
394	56.3	44.8	50.6	43.5	63.9
249	67.1	43.4	43.0	72.3	84.0
MEAN	67.9	59.1	62.4	65.2	66.2
SE	3.8	3.9	5.4	5.1	3.5

1GS4, 1GW4, and 1GS2 denote respectively the 4 hr stand, 4 hr walk, and 2 hr stand treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Urinary Potassium (K), mEq/24 hr					
	1GW2	1GW2	1GW2	1GW2	1GW2
Subject No.	C1	BR1	BR2	BR3	BR4
435	84.0	58.0	70.6	67.0	66.2
439	77.4	99.3	69.8	83.6	75.7
434	66.7	92.5	73.8	71.5	71.4
420	73.1	83.6	76.5	64.9	68.7
243	71.4	74.9	63.5	61.2	60.5
279					
405	93.4	95.5	93.6	69.2	64.8
394	56.6	51.3	62.5	70.0	69.1
249	68.7	53.0	58.1	65.9	69.3
MEAN	73.9	76.0	71.0	69.2	68.2
SE	4.0	7.0	3.9	2.4	1.6

Potassium (K) Balance, mEq/24 hr, determined from Urinary Potassium (K) minus Potassium (K) Intake					
	0G	0G	0G	0G	0G
Subject No.	C1	BR1	BR2	BR3	BR4
435	22.0	31.9	19.3	25.2	27.6
439	52.5	49.4	37.3	13.0	15.2
434	33.0	34.5	18.8	-25.7	18.2
420	15.2	20.3	27.6	15.1	30.2
243	3.6	13.5	17.0	7.3	13.6
279	5.7	-2.4	26.2	-3.4	34.0
405	12.8	34.1	15.9	15.4	22.2
394	57.3	37.3	25.1	17.4	27.9
249	22.3	42.1	46.9	11.9	29.1
MEAN	24.9	29.0	26.0	8.5	24.2
SE	6.4	5.3	3.4	5.0	2.4

0G and 1GW2 denote respectively the no treatment condition and the 2 hr walk treatment condition.
C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Potassium (K) Balance, mEq/24 hr, determined from Urinary Potassium (K) minus Potassium (K) Intake					
Subject No.	1GS4 C1	1GS4 BR1	1GS4 BR2	1GS4 BR3	1GS4 BR4
435	12.4	23.2	13.4	16.8	41.2
439	2.4	5.8	14.7	17.1	29.5
434	47.4	-13.6	7.1	-5.1	-15.5
420	27.4	30.1	24.4	21.5	38.0
243	31.1	17.0	9.0	-2.7	24.8
279	41.6	8.7	10.2	20.5	21.2
405	31.9	17.4	2.2	7.5	30.1
394	65.6	32.2	21.8	16.4	1.8
249	38.6	34.6	22.2	25.1	24.0
MEAN	33.2	17.3	13.9	13.0	21.7
SE	6.2	5.1	2.5	3.6	6.0

Potassium (K) Balance, mEq/24 hr, determined from Urinary Potassium (K) minus Potassium (K) Intake					
Subject No.	1GW4 C1	1GW4 BR1	1GW4 BR2	1GW4 BR3	1GW4 BR4
435	33.6	-14.5	16.4	20.4	27.4
439	29.1	12.1	-11.2	16.3	37.1
434	42.5	1.3	-1.1	24.3	-11.4
420	36.7	-18.7	16.3	-10.3	23.6
243	23.9	4.0	6.0	20.2	20.1
279	53.0	15.4	18.1	23.4	10.3
405	21.1	-30.5	19.6	22.7	8.3
394	41.9	17.8	0.3	5.6	11.8
249	49.7	0.7	45.1	-47.9	24.0
MEAN	36.8	-1.4	12.2	8.3	16.8
SE	3.7	5.5	5.4	8.0	4.7

1GS4 and 1GW4 denote respectively the 4 hr stand and 4 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Potassium (K) Balance, mEq/24 hr, determined from Urinary Potassium (K) minus Potassium (K) Intake					
	1GS2	1GS2	1GS2	1GS2	1GS2
Subject No.	C1	BR1	BR2	BR3	BR4
435	16.9	19.4	14.3	21.6	36.6
439	36.7	24.8	11.9	43.3	32.5
434	10.7	43.5	13.8	5.2	24.3
420	2.2	26.8	30.5	21.5	35.0
243	43.0	30.1	6.6	19.8	33.4
279					
405	26.9	20.7	39.0	2.6	23.2
394	40.1	52.8	36.6	38.7	19.2
249	20.9	38.8	44.5	10.9	14.8
MEAN	24.7	32.1	24.7	20.5	27.4
SE	5.2	4.2	5.2	5.2	2.9

Potassium (K) Balance, mEq/24 hr, determined from Urinary Potassium (K) minus Potassium (K) Intake					
	1GW2	1GW2	1GW2	1GW2	1GW2
Subject No.	C1	BR1	BR2	BR3	BR4
435	17.1	31.4	12.9	22.5	27.6
439	23.8	13.5	13.8	5.6	13.4
434	33.0	-6.5	7.5	15.8	14.2
420	24.5	-0.3	5.7	17.3	11.7
243	27.3	27.8	23.6	20.7	32.5
279					
405	6.1	11.0	-5.8	14.6	28.8
394	40.9	51.6	20.9	12.0	19.9
249	21.2	28.3	22.2	23.4	29.5
MEAN	24.2	19.6	12.6	16.5	22.2
SE	3.7	6.7	3.5	2.1	3.0

1GS2 and 1GW2 denote respectively the 2 hr stand and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Daily Fluid Intake, ml/24 hr					
	0G	0G	0G	0G	0G
Subject No.	C1	BR1	BR2	BR3	BR4
435	2120	2060	2260	2130	1990
439	3503	2814	2814	2569	2244
434	2090	1835	1585	1160	990
420	1265	1130	1445	1130	1250
243	1405	1460	1920	1780	1900
279	1983	1781	1428	1528	1519
405	1985	1890	2080	1690	2115
394	1503	1454	1224	1368	1014
249	1475	1770	1720	1610	1610
MEAN	1925	1799	1831	1663	1626
SE	225	158	166	154	156

Daily Fluid Intake, ml/24 hr					
	1GS4	1GS4	1GS4	1GS4	1GS4
Subject No.	C1	BR1	BR2	BR3	BR4
435	2150	2100	1950	2135	1890
439	1428	1524	1374	1773	1734
434	1460	1080	1395	1110	1140
420	890	1575	1400	1415	1250
243	2235	2200	1945	2250	2140
279	1705	1935	1575	2074	1445
405	1995	2000	1935	2075	2315
394	1029	1080	1300	1230	1035
249	1369	1625	2300	1775	1730
MEAN	1585	1680	1686	1760	1631
SE	158	138	118	140	149

Daily Fluid Intake, ml/24 hr					
	1GW4	1GW4	1GW4	1GW4	1GW4
Subject No.	C1	BR1	BR2	BR3	BR4
435	2360	2250	1970	2320	1930
439	1668	1818	1808	1813	1654
434	1035	1924	1234	1804	1215
420	1519	1909	1990	1920	1550
243	1430	2195	1980	2235	1465
279	2288	2621	2439	2930	1605
405	1990	2070	1890	2065	1650
394	1585	1565	1860	1640	1315
249	1825	1930	2075	2399	1845
MEAN	1744	2031	1916	2125	1581
SE	141	100	105	132	76

0G, 1GS4, and 1GW4 denote respectively the no treatment condition and the 4 hr stand and 4 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Daily Fluid Intake, ml/24 hr					
	1GS2	1GS2	1GS2	1GS2	1GS2
Subject No.	C1	BR1	BR2	BR3	BR4
435	1880	2430	2060	2170	2070
439	1338	1494	1344	1848	1134
434	1504	1045	2035	1345	1190
420	1330	1699	1254	1135	1375
243	2375	2055	2320	1740	1460
279					
405	1945	2000	1990	2000	2085
394	1299	1089	1968	1504	770
249	1685	1345	1610	1760	1505
MEAN	1670	1645	1823	1688	1449
SE	134	174	133	121	160

Daily Fluid Intake, ml/24 hr					
	1GW2	1GW2	1GW2	1GW2	1GW2
Subject No.	C1	BR1	BR2	BR3	BR4
435	2340	2570	2120	2230	1990
439	1338	1730	1879	1729	1434
434	1155	1615	1920	1840	780
420	920	1615	1700	1255	1135
243	1905	1570	2460	2420	1710
279					
405	2000	2000	2000	2000	2000
394	1689	1344	1614	1104	1404
249	1785	1700	1730	1775	1605
MEAN	1642	1768	1928	1794	1507
SE	167	132	96	158	147

Daily Fluid (Urinary) Output, ml/24 hr					
	0G	0G	0G	0G	0G
Subject No.	C1	BR1	BR2	BR3	BR4
435	1839	1852	2058	1855	1361
439	2182	2084	1042	1316	1080
434	2963	1726	1150	1180	1180
420	1429	968	1002	892	1115
243	1375	1595	1620	1340	1460
279	1915	1875	1257	1247	1440
405	2790	1838	2205	1670	2233
394	1080	1676	1045	928	895
249	1675	1598	1140	1640	794
MEAN	1916	1690	1391	1341	1284
SE	212	104	153	110	141

0G, 1GS2, and 1GW2 denote respectively the no treatment condition and the 2 hr stand and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Daily Fluid (Urinary) Output, ml/24 hr					
	1GS4	1GS4	1GS4	1GS4	1GS4
Subject No.	C1	BR1	BR2	BR3	BR4
435	2197	1977	1983	1633	1505
439	1333	1222	1183	1275	1324
434	1827	1060	1140	1047	1110
420	765	863	954	1182	1020
243	1840	2035	2024	1793	1820
279	1420	1548	1633	2124	1366
405	1650	1642	1915	1848	2030
394	1007	1111	1007	1065	1008
249	1670	1480	1960	1275	1191
MEAN	1523	1438	1533	1471	1375
SE	148	136	152	129	119

Daily Fluid (Urinary) Output, ml/24 hr					
	1GW4	1GW4	1GW4	1GW4	1GW4
Subject No.	C1	BR1	BR2	BR3	BR4
435	2435	1525	1112	1307	1534
439	1635	1307	1208	1054	1040
434	1490	1065	975	685	1052
420	1250	1207	905	1051	835
243	1650	1750	1460	1520	1020
279	2465	1259	1500	1842	1040
405	2487	1630	1061	1051	1598
394	773	1006	986	946	1115
249	2025	1485	540	1575	687
MEAN	1801	1359	1083	1226	1102
SE	200	85	97	121	98

Daily Fluid (Urinary) Output, ml/24 hr					
	1GS2	1GS2	1GS2	1GS2	1GS2
Subject No.	C1	BR1	BR2	BR3	BR4
435	2048	2195	2330	1821	2020
439	1385	1465	1347	1204	1158
434	2046	1530	2365	1762	1502
420	1233	2014	989	1400	1395
243	2200	2580	1988	2090	833
279					
405	2449	2642	1672	2110	2195
394	1180	1470	1592	1483	1014
249	1398	2282	1402	2090	1205
MEAN	1742	2022	1711	1745	1415
SE	175	172	172	124	169

1GS4, 1GW4, and 1GS2 denote respectively the 4 hr stand, 4 hr walk, and 2 hr stand treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Daily Fluid (Urinary) Output, ml/24 hr					
	1GW2	1GW2	1GW2	1GW2	1GW2
Subject No.	C1	BR1	BR2	BR3	BR4
435	2780	1840	2057	1203	1891
439	2015	1412	1063	1125	1051
434	1765	1121	1519	1521	898
420	1290	1005	1465	1012	995
243	2635	2080	1615	2060	952
279					
405	2512	2745	1262	2036	1779
394	1465	1180	1275	1057	878
249	1710	1865	1109	1265	1260
MEAN	2022	1656	1421	1410	1213
SE	198	209	114	150	142

Daily Fluid Balance, ml/24 hr, determined from Fluid Out minus Fluid In					
	0G	0G	0G	0G	0G
Subject No.	C1	BR1	BR2	BR3	BR4
435	281	208	202	275	629
439	1321	730	1772	1253	1164
434	-873	109	435	-20	-190
420	-164	162	443	238	135
243	30	-135	300	440	440
279	68	-94	171	281	79
405	-805	52	-125	20	-118
394	423	-222	179	440	119
249	-200	172	580	-30	816
MEAN	9	109	440	322	342
SE	220	92	180	131	151

Daily Fluid Balance, ml/24 hr, determined from Fluid Out minus Fluid In					
	1GS4	1GS4	1GS4	1GS4	1GS4
Subject No.	C1	BR1	BR2	BR3	BR4
435	-47	123	-33	502	385
439	95	302	191	498	410
434	-367	20	255	63	30
420	125	712	446	233	230
243	395	165	-79	457	320
279	285	387	-58	-50	79
405	345	358	20	227	285
394	22	-31	293	165	27
249	-301	145	340	500	539
MEAN	61	242	153	288	256
SE	89	76	65	70	60

0G, 1GS4, and 1GW2 denote respectively the no treatment condition and the 4 hr stand and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

Daily Fluid Balance, ml/24 hr, determined from Fluid Out minus Fluid In					
	1GW4	1GW4	1GW4	1GW4	1GW4
Subject No.	C1	BR1	BR2	BR3	BR4
435	-75	725	858	1013	396
439	33	511	600	759	614
434	-455	859	259	1119	163
420	269	702	1085	869	715
243	-220	445	520	715	445
279	-177	1362	939	1088	565
405	-497	440	829	1014	52
394	812	559	874	694	200
249	-200	445	1535	824	1158
MEAN	-57	672	833	899	479
SE	134	99	121	54	112

Daily Fluid Balance, ml/24 hr, determined from Fluid Out minus Fluid In					
	1GS2	1GS2	1GS2	1GS2	1GS2
Subject No.	C1	BR1	BR2	BR3	BR4
435	-168	235	-270	349	50
439	-47	29	-3	644	-24
434	-542	-485	-330	-417	-312
420	-97	-315	265	-265	-20
243	175	-525	332	-350	627
279					
405	-504	-642	318	-110	-110
394	-119	-381	376	21	-244
249	-287	-937	208	-330	300
MEAN	-199	-378	112	-57	33
SE	84	131	99	134	107

Daily Fluid Balance, ml/24 hr, determined from Fluid Out minus Fluid In					
	1GW2	1GW2	1GW2	1GW2	1GW2
Subject No.	C1	BR1	BR2	BR3	BR4
435	-440	730	63	1027	99
439	-677	318	816	604	383
434	-610	494	401	319	-118
420	-370	610	235	243	140
243	-730	-510	845	360	758
279					
405	-512	-745	738	-36	221
394	224	164	339	47	526
249	75	-165	621	510	345
MEAN	-380	112	507	384	294
SE	124	190	102	119	96

1GW4, 1GS2 and 1GW2 denote respectively the 4 hr walk, 2 hr stand, and 2 hr walk treatment conditions. C1, BR1, BR2, BR3, and BR4 denote ambulatory control and HDBR days.

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1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
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4. TITLE AND SUBTITLE

Intermittent Gravity: How Much, How Often, How Long?

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6. AUTHOR(S)

Joan Vernikos and David A. Ludwig*

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Ames Research Center
Moffett Field, CA 94035-1000

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Point of Contact: Joan Vernikos, Ames Research Center, MS 239-11, Moffett Field, CA 94035-1000; (415) 604-3736
*University of North Carolina, Greensboro, North Carolina

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13. ABSTRACT ***(Maximum 200 words)***

Continuous exposure to gravity may not be necessary to prevent the deconditioning effects of microgravity. It is not known, however, what the minimum gravity (G) exposure requirements are, whether they vary for different physiological systems, or whether passive Gz (gravity in the head-to-toe vector) or activity in a G field is more effective in preventing deconditioning. It is also not known what the optimal characteristics of the G stimulus should be in terms of amplitude, duration, and frequency. To begin to address these questions, we conducted a 4-day –6° head-down bed rest (HDBR) study. Nine males (aged 30–50 yr) were subjected, over a period of seven months, to four different +1 Gz exposure protocols (periodic standing or controlled walking each for a total of 2 or 4 hr/day in individual 15-min doses), plus a control (0 Gz) of continuous HDBR.

The study consisted of one ambulatory control day, 4 full days of –6° HDBR, and a recovery day when subjects were released at the end of HDBR after completion of tests. A battery of tests was selected and standardized in order to evaluate the known early responses to HDBR. Dependent variables of interest included orthostatic tolerance (30 min at 60° head-up tilt) and hemodynamics during head-up tilt, peak oxygen consumption ($\dot{V}O_{2peak}$) plasma volume (PV), and urinary calcium (Ca).

The results were as follows: (1) 4 hr standing completely prevented and 2 hr walking partially prevented post-HDBR orthostatic intolerance. Walking at 3 mi/hr for 4 hr/day provided no additional benefit. (2) Intermittent walking attenuated, but did not prevent, the decrease in $\dot{V}O_{2peak}$. (3) Both 4 hr conditions showed less PV loss by the end of HDBR; both 2 hr conditions were without effect. (4) Both 2 and 4 hr walking essentially prevented urinary Ca excretion and were more effective than standing. It is concluded that different physiological systems benefit differentially from passive +1 Gz or activity in +1 Gz, and the intensity of the stimulus may be an important contributing factor.

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